Report No. DODIG-2013-140

Inspector General

U.S. Department of Defense

SEPTEMBER 30, 2013



Quality Assurance Assessment of the F-35 Lightning II Program



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Results in Brief

Quality Assurance Assessment of the F-35 Lightning II Program

September 30, 2013

Objective

We performed an evaluation of the F-35 Lightning II Program (F-35 Program) by conducting a series of quality assurance assessments of the Joint Program Office, prime contractor, and major subcontractors. We assessed conformity to the contractually required Aerospace Standard (AS)9100, "Quality Management Systems - Requirements for Aviation, Space and Defense Organizations," contractual quality assurance clauses, and internal quality assurance processes and procedures for the following six contractors:

- Lockheed Martin Aeronautics Company, Fort Worth, Texas (Prime Contractor and Aircraft Integrator);
- Northrop Grumman Aerospace Systems, El Segundo and Palmdale, California (Center Fuselage Integrator);
- BAE Systems, Samlesbury, United Kingdom (Aft Fuselage Integrator);
- L-3 Display Systems, Alpharetta, Georgia (Panoramic Cockpit Display System);
- Honeywell Aerospace, Yeovil, United Kingdom (On-Board Oxygen Generation System); and
- United Technologies Corporation, Aerospace Systems, Fort Worth, Texas, and Independence, Ohio (Landing Gear System).

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Findings

The F-35 Program did not sufficiently implement or flow down technical and quality management system requirements to prevent the fielding of nonconforming hardware and software. This could adversely affect aircraft performance, reliability, maintainability, and ultimately program cost. Lockheed Martin Aeronautics Company (Lockheed Martin) and its subcontractors did not follow disciplined AS9100 Quality Management System practices, as evidenced by 363 findings, which contained 719 issues.

The Joint Program Office did not:

- Ensure that Lockheed Martin and its subcontractors were applying rigor to design, manufacturing, and quality assurance processes.
- Flow down critical safety item requirements.
- Ensure that Lockheed Martin flowed down quality assurance and technical requirements to subcontractors.
- Establish an effective quality assurance organization.
- Ensure that the Defense Contract Management Agency perform adequate quality assurance oversight.

In addition, the Defense Contract Management Agency did not:

- Sufficiently perform Government quality assurance oversight of F-35 contractors.

Recommendations

The Joint Program Office should:

- Ensure compliance with AS9100 throughout the F-35 supply chain.

Recommendations Continued

- Ensure that Lockheed Martin approves all design and material review board changes and variances with Government concurrence.
- Perform process proofing of all critical processes to include first article inspections.
- Modify its contracts to include a quality escape* clause to ensure the Government does not pay for nonconforming product.
- Assess the impacts and risks to all delivered aircraft for all findings.
- Implement an aviation critical safety item program that meets the requirements of Public Law and DoD policy, which would include flow down of requirements for a critical safety item program to Lockheed Martin and its subcontractors.
- Assess the impacts and risks to all delivered aircraft for critical safety item deficiencies.
- Perform technical and quality assurance requirement flow down and verification throughout the F-35 supply chain.
- Establish an independent quality assurance organization, which has the authority and resources to enforce the AS9100 standard and F-35 product quality.
- Revise the Defense Contract Management Agency memorandum of agreement to include explicit quality assurance oversight requirements.

* A quality escape is nonconforming material that has entered the product, supply chain, or proceeded beyond the acceptance process.

- Ensure that Defense Contract Management Agency is performing quality assurance oversight commensurate with product criticality.

The Defense Contract Management Agency should:

- Provide a comprehensive quality assurance oversight plan for Joint Program Office approval to be included in the memorandum of agreement.
- Audit the execution of the quality assurance oversight plan throughout the F-35 supply chain.

Management Comments and Our Response

On August 23, 2013, the Joint Program Office and the Defense Contract Management Agency responded to the findings and recommendations in the report. The Joint Program Office agreed with eight recommendations, partially agreed with two, and disagreed with one. The Joint Program Office stated that it does not have the resources to perform process proofing of all critical processes nor has the responsibility or resources to perform requirement flow down verification throughout the F-35 supply chain. However, we disagree because it is the Joint Program Office's responsibility to ensure contractual compliance to prevent nonconformances. It is also the responsibility of the Joint Program Office to update the contract if the requirements are deficient.

It was also our recommendation that Joint Program Office establish an independent quality assurance organization

Management Comments and Our Response Continued

reporting to the Program Manager. The Joint Program Office disagreed stating that the Defense Contract Management Agency performs the role of the independent quality assurance organization for the F-35. We disagree because the Defense Contract Management Agency is not accountable for program quality assurance goals. An independent quality assurance organization reporting directly to the Program Manager would ensure that performance and reliability objectives are met.

The Defense Contract Management Agency agreed with one recommendation and partially agreed with the second. The Defense Contract Management Agency stated that it would update the memorandum of agreement between the Defense Contract Management Agency and the Joint Program Office, regarding surveillance; however, we disagree and desire specifics on the level of oversight at contractor facilities.

The following table identifies recommendations requiring an additional comment by the Joint Program Office and Defense Contract Management Agency. Please see the Overall Findings and Recommendations section in the report for details.

Recommendations Table

Management	Recommendations Requiring Comment	No Additional Comments Required
Joint Program Office	A.3, B.2, C, D, and E.1.b	A.1, A.2, A.4, A.5, B.1, E.1.a
Defense Contract Management Agency	E.2.a and b	

*Please provide comments by October 28, 2013.

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

September 30, 2013

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER
DIRECTOR, DEFENSE CONTRACT MANAGEMENT AGENCY

SUBJECT: Quality Assurance Assessment of the F-35 Lightning II Program (Report No. DODIG-2013-140)

The DoD Inspector General (IG) conducted a quality assurance assessment of the F-35 Lightning II aircraft procured from Lockheed Martin. We conducted the assessment at the Joint Program Office (JPO), onsite at Lockheed Martin, and at the major subcontractors during FYs 2012 and 2013. Our objective was to assess quality assurance conformity to regulatory and contractual requirements necessary for F-35 aircraft production.

Our assessment determined that the F-35 JPO oversight of Lockheed Martin was inadequate and that the Defense Contract Management Agency (DCMA) oversight of the contractors was ineffective. These issues may result in nonconforming hardware, less reliable aircraft, and increased cost. Throughout the assessment, we issued Notices of Concerns to the F-35 JPO to ensure timely corrective action of our findings. It is our understanding that the JPO has been implementing corrective actions and the DoD IG will perform future assessments of this critical program.

The draft version of our report made recommendations to the F-35 JPO and DCMA to ensure compliance with quality management standards throughout the F- 35 supply chain and to assess the impacts and risks to all delivered aircraft. We considered management comments on the draft from JPO and DCMA. We request further comments from the JPO on Recommendations A.3, B.2, C, D, and E.1.b and from DCMA on Recommendations E.2.a and E.2.b. Further comments should be received by October 28, 2013.

DoD Directive 7650.3 requires that recommendations be resolved promptly. If possible, send a .pdf file containing your comments to alois.dopita@dodig.mil. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to our staff. Please direct questions to Mr. Al Dopita at (703) 699-0220 or alois.dopita@dodig.mil.

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

cc: Under Secretary of Defense for Acquisition, Technology and Logistics
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Naval Inspector General
Auditor General, Department of the Navy

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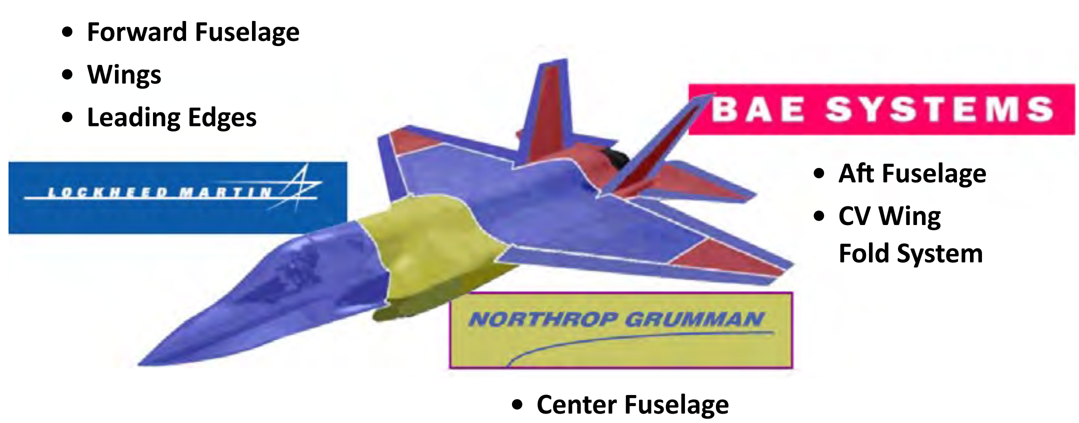
Our objective was to assess the F-35 Lightning II Program (F-35 Program), Joint Program Office (JPO), the prime contractor, and major subcontractors conformity to the contractually required Aerospace Standard (AS)9100, "Quality Management Systems - Requirements for Aviation, Space and Defense Organizations," contractual quality assurance clauses, and internal quality assurance processes and procedures.

Background

The F-35 Program is a joint, multinational acquisition to develop and field an affordable, next-generation strike fighter aircraft for the Navy, Air Force, Marine Corps, and eight international partners: the United Kingdom, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway. The F-35 has three variants. The Conventional Takeoff and Landing (CTOL), Short Takeoff and Vertical Landing (STOVL), and Carrier-Suitable Variant (CV).

Lockheed Martin Aeronautics Company (Lockheed Martin) entered system development and demonstration in October 26, 2001. Lockheed Martin has two principal subcontractors/suppliers, Northrop Grumman Aerospace Systems (Northrop Grumman) and BAE Systems (BAE). Figure 1 shows the breakdown of the manufacturing for major assemblies between Lockheed Martin and the principal subcontractors. The program has about 1,300 other suppliers, with production occurring in 47 states and Puerto Rico. Additionally, production is occurring in more than 600 suppliers in 30 other countries.

Figure 1. Manufacturing Breakdown of F-35 Major Assemblies
Source: Image courtesy of JPO



According to the Government Accountability Office reports, JPO rebaselined the F-35 Program in 2004 following weight and performance problems and rebaselined again in 2007 because of additional cost growth and schedule delays. In March 2010, JPO declared that the program exceeded critical cost growth thresholds established by statute—a condition known as a Nunn-McCurdy breach. JPO continued extensive restructuring actions during 2011 and 2012 that added more funding, extended schedules, and further reduced aircraft procurement quantities in the near-term. The quantity of F-35 aircraft to be procured was not changed, but restructured plans deferred the procurement of 410 aircraft until 2017. In March 2012, JPO established a new acquisition program baseline for the F-35 program, which incorporated all program restructuring actions. The March 2012 baseline represented the fourth rebaseline since the program's inception.

According to the latest acquisition strategy, the F-35 Program is one of concurrent development, production, and sustainment with nine separate low-rate initial production (LRIP)[1] deliveries. Each LRIP represents an increasing level of maturity as additional system capability is delivered. Each LRIP also represents its own contract that establishes the number of aircraft to be produced and its own acquisition approach. For LRIPs 1 through 3, JPO's acquisition approach was cost-plus incentive/award/fixed fee, but for LRIPs 4 through 9 a fixed-price incentive (firm target) type contract is being used. The contract fee methodologies also differ for the various efforts on each contract with incentive fee for cost and schedule, award fee for timeliness and quality, and fixed fee for diminishing manufacturing sources.

Quality Trend Data

F-35 Program quality metric data show improvement in scrap, rework, and repair rates and in software and hardware quality action requests per aircraft. However, the Government incurred and will continue to incur a significant cost for these issues, either through the previous cost-plus incentive/award/fixed-fee contracts or via quality incentives on future fixed-price incentive-fee contracts. As of March 2013, metric data showed that there were, on average, 972 quality action requests per aircraft for LRIP 1, 987 for LRIP 2, 926 for LRIP 3, and 859 for LRIP 4. Scrap, rework, and repair rates on average per aircraft were 13.82 percent for FY 2012 and 13.11 percent for FY 2013, thus showing only a moderate change towards reducing costs. Although it would be unrealistic to expect first production to be issue free, our contractor assessments indicate that greater emphasis on quality assurance, requirement flow down, and process discipline is necessary, if the Government is to attain lower program costs.

[1] LRIP as defined by the Defense Acquisition University is the "effort intended to result in completion of manufacturing development in order to ensure adequate and efficient manufacturing capability and to produce the minimum quantity necessary to provide production or production-representative articles for Initial Operational Test and Evaluation."

Assessment Criteria

AS9100 Standard

The F-35 LRIP contracts require that the contractor comply with AS9100. We performed our assessments to the AS9100C standard because it was the current version at the time of the assessments, and any defense contractor obtaining certification would be required to meet that standard.

The AS9100C standard breaks down quality assurance requirements into five major clauses:

- Quality Management System,
- Management Responsibility,
- Resource Management,
- Product Realization, and
- Measurement, Analysis, and Improvement.

The Quality Management System, Management Responsibility, and Resource Management clauses require the organization to have a quality assurance management organization that has all the resources and authority to affect the end-item quality of the product. In addition, it requires the organization to have a quality assurance manual and strict controls over all documentation, data, and procedures that affect the quality of the product. Product Realization covers the activities and processes necessary to bring a product into existence.

Product realization is broken down further in AS9100 as follows:

- Planning of Product Realization,
- Customer-Related Processes,
- Design and Development,
- Purchasing,
- Production and Service Provision, and
- Control of Monitoring and Measuring Equipment.

Planning of Product Realization requires the organization to develop processes needed for design and development of product and includes elements such as procedures, quality assurance records, resource requirements, safety and reliability programs, and

inspection and test. Design and Development includes requirements that cover planning, inputs, outputs, review, verification, validation, and control of changes as related to design and development. Purchasing requires the organization to ensure that the purchased product conforms to specified purchase requirements and that all products purchased from suppliers are verified against purchase agreement requirements. The Production and Service Provision requires the organization to ensure that production is accomplished under controlled conditions using drawings and specifications, work instructions, production tools and software programs, monitoring and measuring equipment, and evidence that all production and inspection/verification operations have been completed as planned.

Measurement, Analysis, and Improvement requires the organization to ensure the product continuously improves. The clause includes customer satisfaction, internal audit, monitoring and measuring processes and product, and control of nonconforming products to ensure continual improvement.

Aviation Critical Safety Items Requirements

In addition to AS9100, we assessed the JPO and the contractor's implementation of aviation critical safety items (CSIs) requirements. A CSI is a part, assembly, or support equipment whose failure could cause loss of life, permanent disability or major injury, loss of a system, or significant equipment damage. Special attention should be paid to CSIs to prevent the potential catastrophic or critical consequences of failure. CSIs require special handling, engineering, manufacturing, and inspection documentation to control and ensure safety of flight.

Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," requires DoD to prescribe a quality control policy for the procurement of aviation CSIs. Joint Service CSI Instruction, "Management of Aviation Critical Safety Items," implements the DoD CSI program and establishes the policies, procedures, and responsibilities to manage CSI. The Joint Aeronautical Commanders Group (JACG), "JACG Aviation Critical Safety Item Handbook," implements the policies in the Joint Service CSI Instruction and describes the technical and quality assurance requirements for a Prime Contractor CSI program.

Statutory and Regulatory Requirements

Additionally, we assessed the compliance of applicable statutory and regulatory requirements to include requirements in the Federal Acquisition Regulation;

DoD Instruction 5000.02, "Operation of the Defense Acquisition System," Enclosure 4; and DoD 4140.1-R, " DoD Supply Chain Materiel Management Regulation," Section C3.6.

Quality Assurance Assessment Process

To evaluate the JPO's management of the F-35 quality assurance program, we performed a series of quality assurance assessments of JPO, prime contractor, and major subcontractors. We assessed conformity to the contractually required, AS9100, contractual quality assurance clauses, internal quality assurance processes, and procedures for the following six contractors:

- Lockheed Martin Aerospace Company, Fort Worth, Texas (Prime Contractor and Aircraft Integrator);
- Northrop Grumman Aerospace Systems, El Segundo and Palmdale, California (Center Fuselage Integrator);
- BAE, Samlesbury, United Kingdom (Aft Fuselage Integrator);
- L-3 Display Systems (L-3), Alpharetta, Georgia (Panoramic Cockpit Display System);
- Honeywell Aerospace (Honeywell), Yeovil, United Kingdom (On-Board Oxygen Generation System); and
- United Technologies Corporation, Aerospace Systems (UTAS), Fort Worth, Texas and Independence, Ohio (Landing Gear System).

We selected the contractors based on product criticality and risk. For each assessment, we established teams of engineering and subject matter experts who assessed to the AS9100C Quality Management System standard. The subject matter expert teams consisted of 14 to 18 quality assurance engineers, trained and certified in AS9100, who had an average of 15 years of quality assurance audit experience. Additionally, at the Lockheed Martin, Northrop Grumman, and BAE assessments, we included a team that evaluated the aviation CSI process.

This assessment focused on quality management system compliance. We did not examine whether financial restitution was granted for nonconformances, variances, waivers, deviations, etc.

Notice of Concern

At the conclusion of each contractor assessment, we issued a notice of concern (NOC) to the JPO to ensure timely corrective action of each finding. The NOCs included the detailed findings from that location to ensure prompt resolution.

Classification and Categorization of Findings

We wrote 363 findings that identified a total of 719 issues for the six[2] contractor assessments performed. There were multiple issues identified in most of the findings with the majority of issues were violations of the AS9100C Quality Management System standard. For each of the assessments, we classified the findings as major nonconformances, minor nonconformances, or opportunities for improvement (OFIs). Each finding received an additional technical review for accuracy and classification.

As defined by the AS9101 standard, a *major* nonconformance is a nonfulfillment of a requirement that is likely to result in the failure of the quality management system or reduce its ability to ensure controlled processes or compliant products/services. A *minor* nonconformance is a nonfulfillment of a requirement that is not likely to result in the failure of the quality management system or reduce its ability to ensure controlled processes or compliant products or services. An *OFI* is an industry best practice where a specific requirement does not exist. This report focuses on the major findings for each respective contractor.

The table shows the breakdown of *major*, *minor*, and *OFI* findings for each of the site assessments.

*Table. Major/Minor/OFI Finding Totals at Each Site**

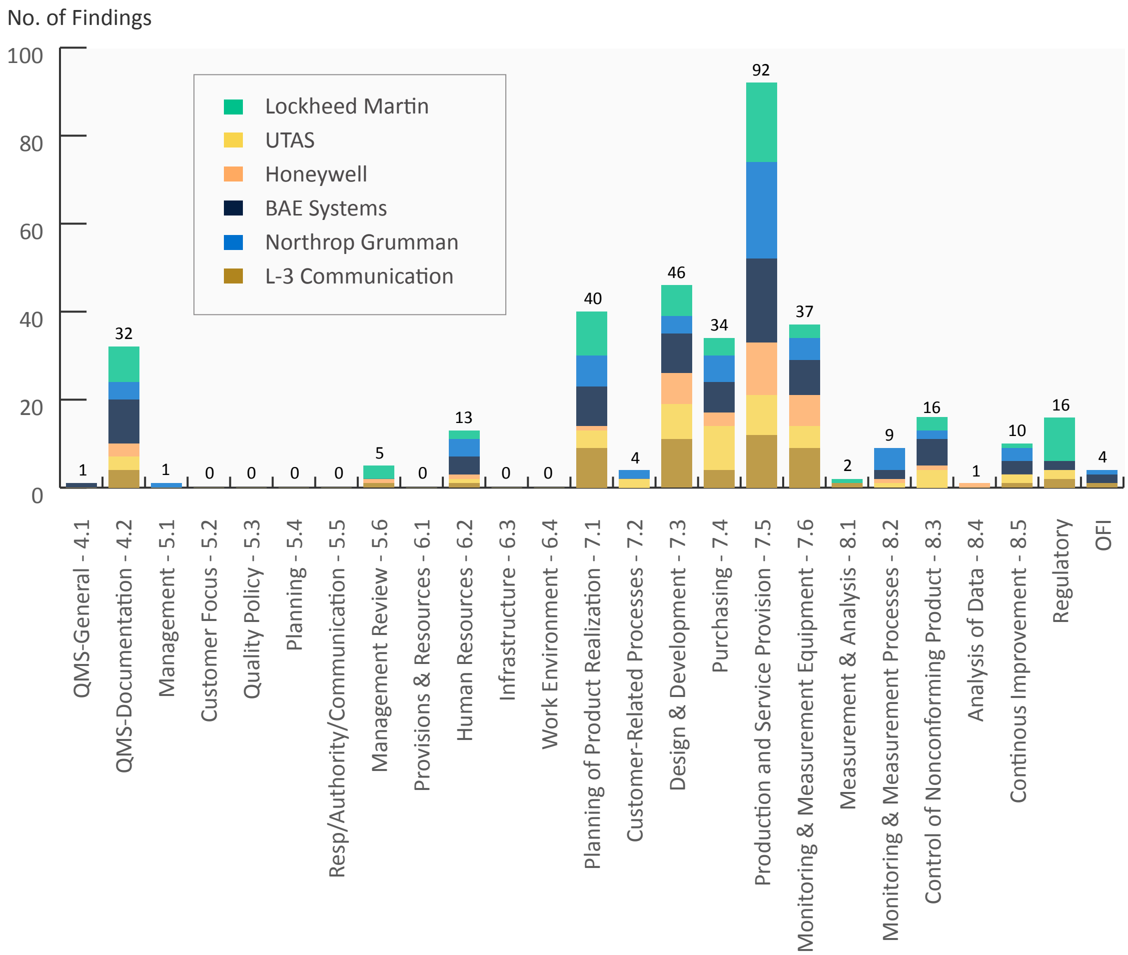
Location	Major	Minor	OFI
Lockheed Martin	28	42	0
Northrop Grumman	23	42	1
BAE	36	44	2
L-3 Communications	25	30	1
Honeywell	18	20	0
UTAS	17	34	0
Total	**147**	**212**	**4**

*Findings include those written against JPO and DCMA during the respective assessments.

[2] We conducted a pre-assessment visit at Honeywell, Phoenix, Arizona. Although the site was not selected for assessment, we wrote one finding against the Defense Contract Management Agency.

For each of the contractor assessments, we categorized the findings by the relevant AS9100C clause. Figure 2 provides the breakdown of these findings for the overall assessment

Figure 2. Categorization of Findings



Contractor Assessments

Lockheed Martin Aeronautics Company (Prime Contractor)

(Fort Worth, Texas)

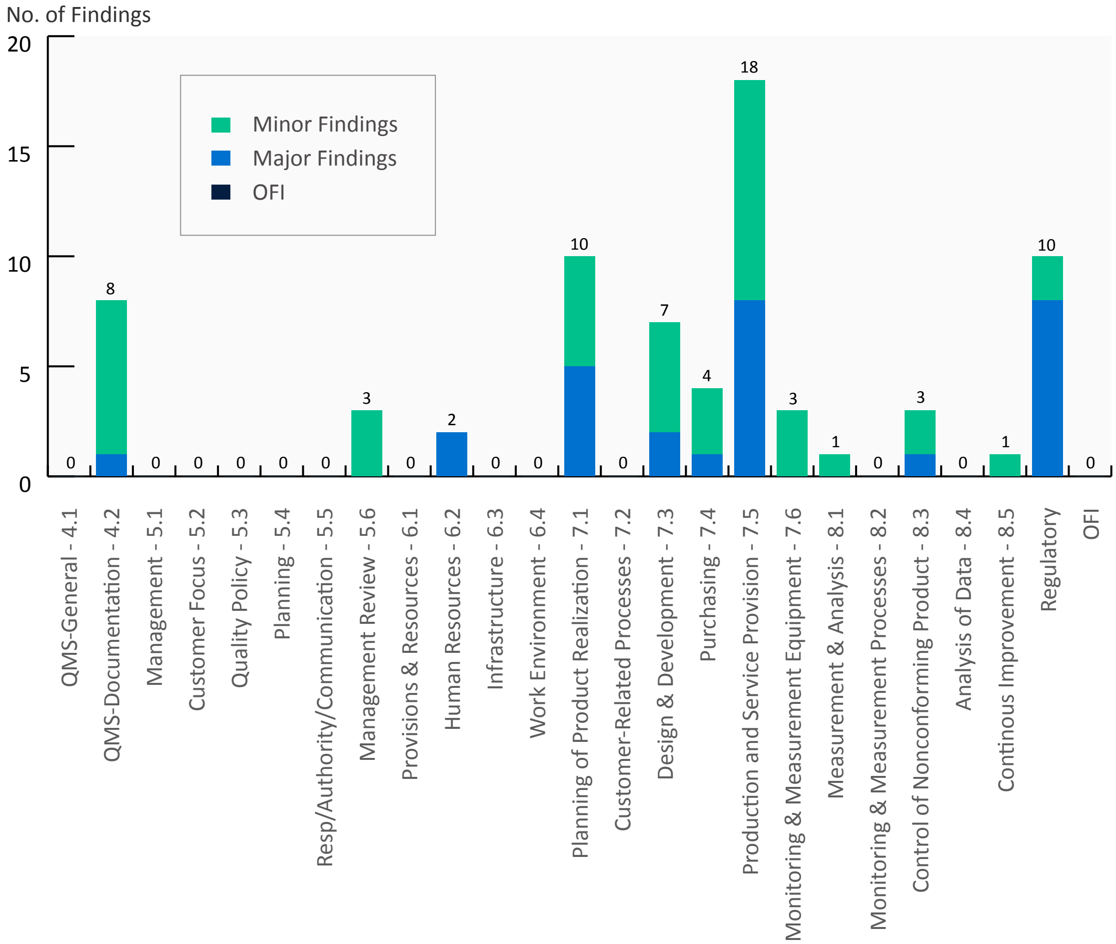
Lockheed Martin is the prime contractor and lead integrator for the F-35 Program. Lockheed Martin manufactures the forward fuselage and wings and performs final integration and final aircraft verification at the Fort Worth, Texas, facility (Figure 3).

Our assessment of Lockheed Martin resulted in 70 findings that identified weaknesses in Lockheed Martin's implementation of an AS9100 Quality Management System. Many of the issues documented in the findings indicate additional F-35 Program risks that could impact cost, schedule, and performance. We wrote an additional 24 findings against Lockheed Martin stemming from our assessments at its subcontractor sites (7 at L-3 Communications, 5 at Northrop Grumman, 7 at BAE, and 5 at UTAS). Figure 4 provides the Lockheed Martin findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.



Figure 3. Lockheed Martin Assembly Line Source: Image courtesy of Lockheed Martin

Figure 4. Lockheed Martin Findings



Documentation Requirements (4.2)

We wrote several findings regarding documentation control. For example, the material data system that automatically records the cumulative product excursion time[3] of composites prior to curing requires corrective action. When products required a secondary lay-up, the excursion time continued to accumulate in the material data system, even though the product cured. To preclude the appearance that the materiel had exceeded its useful life, operators were overriding the automated materiel data system with manual entries. We could not determine if these manual entries accurately reflected the actual excursion time of the material. The ability of operators to override the recorded excursion time data prevents the data record from reflecting whether the final product conformed to requirements.

[3] The excursion time reflects the amount of time available for the operator to use the material, typically for bonding agents.

Other findings documented similar record control deficiencies including maintenance of flight line security logs and unclear record retention requirements. In addition, several procedures, checklists, and program plans were in use prior to approval and formal release. Lockheed Martin personnel were using unapproved (without engineering and quality assurance approval) procedures for 18 months. The unapproved procedures were used to control the vacuum hold-down fixtures for both the flexible overhead gantry machining and coordinate measurement machine. In addition, the manufacturing plans for the wing systems and wing structures were labeled as "uncontrolled/for reference only," although they were used by the planning department to develop the work instruction for aircraft assembly. Maintaining accurate product records and controlling process documentation is necessary to ensure that the product meets engineering and customer requirements.

Human Resources (6.2)

Competence, Training, and Awareness (6.2.2). We found Lockheed Martin's management had not updated the employee training requirement to reflect actual training needs. The Learning Management System included 80 employees with expired certifications such as ejection seat installation and removal, F-35 egress system safety, and explosives care, handling, and storage. In addition, employee training plans identified training certifications that were not required for the jobs those employees were performing. In another example, 37 operators were working on flight hardware in a foreign object debris/damage (FOD)-control area without current certifications. A subsequent major finding, noted later in this report (see paragraph 7.5.5), documented that FOD was discovered in FOD-critical and FOD-control areas. Training ensures operators are cognizant of the latest industry standards and techniques; it also provides increased awareness. The lack of management attention to certification requirements of employees working in aircraft assembly areas places the delivered product at risk.

Planning of Product Realization (7.1)

We identified several major findings in Lockheed Martin's Planning of Product Realization. A major finding noted that Lockheed Martin's shop floor planning contained incorrect verification steps that resulted in verifications either not being completed or unnecessary. For example, the center wing mate assembly work instruction required torque verification for fasteners; however, fasteners involved in this operation did not require torqueing. In another instance, the wing systems installation work instructions required performing two verifications; one for verification of the electrical bond and the other for electrical resistance. A review of drawing requirements and discussions

with personnel noted that the operators were not required to perform the electrical resistance verification, even though it was later determined to be required. Finally, the wing system installation work instructions identified two different inspection criteria for electrical bond resistance inspection; however, it did not specify which one applied.

Another major finding noted that manufacturing documentation did not identify an inspection requirement that would verify that sealing of fasteners on skin installations met dimensional requirements. Specifically, the drawing specified minimum fillet dimensions for integral fuel tank sealing; however, the dimensions were only inspected visually and were not measured. Sealing adds weight to the aircraft and because measurements were not taken, it is unclear whether this would be accounted for in final system performance.

Planning and procedures in several process areas lacked sufficient detail to provide adequate work instructions. For example, in the metal machining areas, the procedures did not identify details regarding part cleaning, setup, and mechanical clamping; and in the wing assembly area, the fillet sealing tools were not identified in the procedure, and personnel were using unspecified tools. Also, a specification for the integral fuel tank sealing had numerous errors in the graphics depicting dimensional identification along with missing, incomplete, or incorrect dimensional lines. In the wing box integration area of the facility, the planning did not detail numerous operations for skin panel cover closeout. This lack of precise and accurate work instructions could result in nonconformances later in processing or after fielding, thus causing schedule delays and additional program costs.

A major finding noted that Lockheed Martin was not implementing its diminishing manufacturing sources and materiel shortages (DMSMS) process in accordance with internal procedures. For example, Lockheed Martin did not always include the requirement for the delivery of bills of materials in its supplier statement of work (SOW) and did not always upload subtier supplier bills of materials into its obsolescence-forecasting tool. This precluded Lockheed Martin from proactively managing DMSMS. Cost metrics provided by Lockheed Martin indicate that the cost of DMSMS has been increasing. Proactive management of DMSMS is critical for containing program cost.

Lockheed Martin had not assessed the use of lead-free electronic parts throughout the F-35 Program as required by its own corporate requirements, "Lockheed Martin Corporation Lead-Free Control Plan." Lockheed Martin did not flow down a lead-free control plan requirement to its suppliers. The use of lead-free electronic parts in critical

applications increases the risk to component service life, reliability, airworthiness, and safety because of tin whisker growth.[4]

A final major finding identified that Lockheed Martin did not always define the capability confirmation criteria used for acceptance of aircraft. In some cases, confirmation criteria did not include clearly measurable and verifiable acceptance criteria, or were not traceable to source data necessary to confirm the required capability. As a result, acceptance of F-35 aircraft depends on the judgment of individual subject matter experts without the use of clearly measurable and verifiable acceptance criteria to confirm the capability of the aircraft. Unclear capability confirmation criteria in the configuration and capability description documents can lead to inconsistencies or quality escapes[5] during acceptance of LRIP aircraft.

Configuration Management (7.1.3). Our assessment identified that Lockheed Martin neither adequately provided review or approved of engineering change submittals made by Lockheed Martin's critical suppliers. Specifically, Lockheed Martin neither approved or disapproved all L-3 major changes nor provided concurrence in classification for all minor changes submitted by L-3 and UTAS. L-3 submitted 8 major engineering change proposals to Lockheed Martin since May 7, 2007, with no evidence of approval or disapproval, and 14 minor changes through engineering change notices during 2011, with no response for "concurrence in classification." This indicates a breakdown in a basic quality assurance process used to ensure that Lockheed Martin's systems engineering understand and agree or disagree with supplier product changes. Another major finding noted that Lockheed Martin did not require L-3 to perform configuration status accounting for LRIP 1 through 5 delivered aircraft. Failure to require suppliers to perform configuration status accounting of delivered hardware can result in the inability to provide hardware traceability in support of failure analysis, system upgrades, and supportability of the aircraft. Lockheed Martin's configuration management processes did not define configuration management board membership and authorities. In addition, the configuration management plan, imposed on BAE by Lockheed Martin, had invalid references and processes for BAE to follow.

Design and Development (7.3)

Design and Development Planning (7.3.1). A major finding identified that Lockheed Martin was delivering F-35 aircraft that did not meet required interchangeability-

4 A phenomenon known as "tin whiskers" becomes a factor due to the absence of lead in tin-bearing solder and component finishes. Tin whiskers can cause electrical shorts resulting in system failures.

5 A quality escape is nonconforming material that has entered the product, supply chain, or proceeded beyond the acceptance process.

replaceability contract requirements dating back to 2001. This deficiency was identified in May 2009 by the Defense Contract Management Agency (DCMA). Lockheed Martin identified this as a high-risk item and developed a 35-step plan for mitigation; however, final mitigation is not expected to be complete until 2015. The interchangeability-replaceability plan was to validate through demonstration 277 interchangeability-replaceability components that were primarily comprised of aircraft skin assemblies. At the time of our assessment, 273 demonstrations were still required and it was estimated that 150 aircraft would be fielded before completing the plan. This will inevitably create fielded aircraft components that are not interchangeable or additional cost to the Government for bringing fielded aircraft up to specification.

A software safety engineer was not assigned to the software development integrated product team (IPT), as required by the Software Development Plan, to ensure that software meets all safety requirements. Without adequate product evaluation of mission system software, Lockheed Martin cannot ensure aircraft safety requirements are met.

Lockheed Martin's Mission Systems Software Development Plan did not address all the requirements of failure mode testing specified in the Air Systems Software Development Plan. Additionally, the Test Readiness Review for air system software block 2A did not contain exit criteria, as required by the Systems Engineering Plan. If requirements are not specified in the program plans, and technical reviews do not contain exit criteria, the aircraft design may not meet all program requirements.

Lockheed Martin was not providing adequate management of the development efforts at critical suppliers. Multiple findings were written regarding Lockheed Martin's failure to flow down development planning requirements. During the UTAS assessment, we found that Lockheed Martin flowed down the F-35 Brake/Skid Control System performance-based specification with incomplete and conflicting specification requirements and did not flow down required safety and mission-critical function information. Additionally, Lockheed Martin provided incomplete, conflicting, and ambiguous system requirements in the Panoramic Cockpit Display performance specification to L-3.

During the Northrop Grumman assessment, we identified that Lockheed Martin did not maintain mission systems requirements traceability to the software-level requirements. Specifically, the requirements were not derived from or traceable to the allocated software requirements and the top-level system requirements. Untraceable requirements cannot be verified for impact on system performance. In addition, Lockheed Martin did not maintain the air system block plan to reflect current capabilities planned for the F-35 Program software blocks. The plan had not been updated since August 2008 and did

not reflect current block planning, which would define air system capabilities. As a result, there is no authoritative document defining current and planned software capabilities. Without a current air systems block plan, software program capabilities may not be implemented when required.

During the BAE assessment, we identified that Lockheed Martin was not ensuring that BAE was working to the current revision of the software development plan for the F-35 mission systems software. Software products developed by BAE using outdated mission systems requirements may not contain current development processes and acceptance criteria. In addition, several of the F-35 subsystem, software development plans did not include software maintenance, even though the software was already in the maintenance phase.

For some critical design reviews (CDRs), Lockheed Martin did not establish or require exit criteria. Additionally, Lockheed Martin did not formally close all design review action items and did not disposition or approve the UTAS failure modes, effects, and criticality analysis (FMECA) reports for the main and nose landing gear.

The lack of part interchangeability, insufficient requirement flow down, and open design review action items, as well as failing to evaluate and approve or disapprove engineering deliverables represent product instability and risk.

Purchasing (7.4)

Our assessment documented several findings citing inadequacies in Lockheed Martin's oversight of its suppliers and management of subcontractor deliverables. For example, a major finding noted that Lockheed Martin did not manage subcontractor deliverables in accordance with the approved process. Many of the deliverables identified in the subcontract SOW and associated subcontractor deliverable requirements lists had not been delivered or were delivered more than 2 years late without follow-up by Lockheed Martin. Several of these deliverables; such as the software development plan, configuration management process plan, manufacturing plan, electronic bill of materials, advanced quality assurance plan, and acceptance test plan; still require concurrence or approval by Lockheed Martin. Additionally, the data management system for tracking the status of supplier deliverables contained inconsistent information with requirements contained in the subcontract deliverable requirements lists.

Several other findings noted inconsistencies in the supplier management and control process. For example, Lockheed Martin did not always conduct supplier evaluations as required. Additionally, the evaluation process for software suppliers did not adequately identify requirements for supplier approval and control, such as a detailed supplier

approval process, detailed oversight strategy, supplier risk levels, and the periodicity for supplier selection audits or in-process supplier audits. These evaluations are a primary input into the supplier rating program. In another finding, several suppliers were issued corrective action requests; however, these suppliers were delinquent in responding to the requests and Lockheed Martin did not follow-up to determine the status. Lockheed Martin cannot ensure suppliers are meeting program requirements without a robust supplier management system.

Production and Service Provisions (7.5)

Control of Production and Service Provision (7.5.1). Lockheed Martin was not following established procedures to maintain production control. For example, several mechanics were violating procedures by not wearing gloves while installing the fasteners for the wing close-up operation. These particular fasteners have a chemical film dry lube coating on the threads and require gloves to avoid contamination during installation. In addition, an operator performing the nutplate push test for the CTOL wing was not pushing the required amount of time at each test point resulting in uncertainty that proper epoxy adhesion was obtained.

Two findings documented a lack of adherence to procedures regarding rework and repair documentation. Lockheed Martin performed rework on the Rear Spar Brackets without issuing a quality assurance report. Another finding identified undocumented damage to the aluminum shims of an aircraft assembly. Assembly personnel notified the supervisor of the approximate 3x12 inch damaged area to the aluminum shims; however, they did not write a nonconformance report in compliance with Lockheed Martin process. Nonconforming product should be identified and dispositioned by the appropriate engineering expertise to ensure sufficient repair and eliminate future occurrences. As a result, a serious quality escape could occur, affecting reliability or safety of flight.

Production Process Verification (7.5.1.1). Several First Article Inspection (FAI)[6] findings were documented against Lockheed Martin. The purpose of FAI is to obtain a representative production sample and ensure that all key design characteristics have been achieved, critical processes are controlled, and unit-to-unit repeatability is attained.

A major finding documented several deficiencies with Lockheed Martin's application of the FAI process. Specifically, Lockheed Martin applied AS9102 guideline requirements inconsistently. AS9102 establishes the requirements for performing and documenting

[6] AS9102 defines FAI as, "A complete, independent, and documented physical and functional inspection process to verify that prescribed production methods have produced an acceptable item as specified by engineering drawings, planning, purchase order, engineering specifications, and/or other applicable design documents."

FAIs. Lockheed Martin imposed this standard on all suppliers of F-35 critical assemblies; however, it did not require conformance to AS9102 on a product fabricated within its own facility. In addition, Lockheed Martin's FAI process focused primarily on a 100-percent inspection of products that met engineering requirements and did not include verification of process stability and personnel proficiency. These tenets are required by AS9102, on which Lockheed Martin based its FAI plan. Finally, AS9102 does not exclude assemblies from FAIs, but Lockheed Martin excluded FAIs on major assemblies such as the wings, tail, forward, center, and aft fuselage sections of the aircraft. Many process changes at Lockheed Martin were occurring in the major assembly areas and involved moving tooling and equipment to perform out-of-station work. According to AS9102, changes in manufacturing processes, location of manufacture, tooling, or materials provide the rationale for performing or reperforming full or partial FAIs. Overall, Lockheed Martin's FAI process was ineffective, as evidenced by the numerous planning, tooling, and training deficiencies documented.

We found that Lockheed Martin flowed down conflicting FAI requirements to BAE and Northrop Grumman. Specifically, the contractually imposed AS9102 standard requires that FAIs be performed on all components, including assemblies. However, Lockheed Martin's FAI plan exempts many of the major assemblies and subassemblies from FAIs. This conflict resulted in many items not receiving FAIs. Additionally at L-3, Lockheed Martin had approved variances for L-3 to ship display units and electronics units to Lockheed Martin without completing FAIs; another indicator of Lockheed Martin's disregard for the FAI process.

Failure to adequately perform FAIs could impact the F-35 Program's ability to achieve process stability and successfully meet program global production rate goals. The lack of process stability will increase costs and schedule because of discrepant hardware and quality escapes.

Control of Production Equipment, Tools, and Software Programs (7.5.1.3). The assessment identified a major deficiency with documenting the control of manufacturing tooling used on the F-35 Program. Lockheed Martin personnel were using discrepant sealant mixing equipment for production. Without engineering approval or analysis, Lockheed Martin personnel were mixing the sealant (for the skin installation of the left aft wingbox) at twice the required time to compensate for the discrepant machine. Furthermore, the compensation time used was incorrect, thus resulting in possible over mixing of the sealant. Other findings noted that additional equipment was not maintained, including the vacuum system equipment used for composite machining operations, another sealant mixer, and software for computer numerically controlled machines.

Preservation of Product (7.5.5). We documented major findings related to control of FOD and shelf-life material. For instance, controls were inadequate to prevent FOD from being introduced onto the production floor. A DoD Office of Inspector General (OIG) walkthrough identified FOD within FOD-critical areas located in the final assembly production area and flight line run stations. Examples include metal shavings found throughout the left air intake of the aircraft, leaking fluid from a bagged hydraulic line, and a paper tag below the aircraft. FOD was also identified in FOD-control areas located in the electronic mate, alignment system, and final assembly production areas. Examples include metal shavings found in the cockpit of the aircraft; and metal fasteners, wood fibers, and miscellaneous tools and debris throughout the production area. Another major finding documented several incidents where wiring harness protective connector caps were missing. The caps are designed to prevent both FOD and electrostatic damage to aircraft components and circuitry during manufacturing.

We found expired composite material and a process lay-up kit with improperly identified shelf life and excursion times. These items were not impounded to prevent unintended use. Failure to properly identify and maintain traceability of shelf-life material may lead to use of material that does not meet specifications, potentially resulting in degraded material performance and failure.

Control of Nonconforming Product (8.3)

Airframes measured using the laser alignment system routinely did not meet mate and alignment drawing requirements; however, Lockheed Martin did not identify that the airframes were discrepant. Numerous airframes for all three aircraft variants have been integrated into end-item flight hardware and processed through final assembly but Lockheed Martin did not identify and disposition the nonconformances. Two other findings identified three separate instances when "Open" nonconformances were not identified and subsequently removed in accordance with procedures. The effective identification, review, and disposition of nonconforming product is essential to prevent processing of defective hardware into the aircraft.

Improvement (8.5)

Corrective Action (8.5.2). We wrote several findings regarding Lockheed Martin's corrective action process. At the L-3 assessment, Lockheed Martin approved variances that waived performance requirements for the electronics and display units. The variances did not contain documented corrective actions that would prevent the need for repeated variance requests. There were 17 performance variances on the display unit

and 8 performance variances on the electronic unit. L-3 continues to produce and deliver electronics and display units with performance issues under these variances.

At the Northrop Grumman assessment, the software tool (Eagle Speed) that Lockheed Martin provided to Northrop Grumman did not include identification and recording of software nonconformance root cause as required in the F-35 mission systems software development plan. This tool tracks and manages mission systems software problem anomaly and software problem reports. Without identification of the root cause of software problems, Lockheed Martin cannot conduct effective corrective action to address software deficiencies.

Joint Program Office Oversight of Lockheed Martin

The CSI findings documented at Lockheed Martin, Northrop Grumman, and BAE Systems indicate that JPO had not established a CSI program for the F-35 Program.

JPO had not flowed down a contractual requirement to Lockheed Martin (and subsequently, its subtier suppliers) to implement a CSI management program in accordance with Public Law and DoD Policy. CSIs require special handling, engineering, manufacturing, and inspection documentation to control and ensure safety of flight. Without a CSI program, there is an increased safety risk to the aircraft and warfighter.

Another major finding noted that JPO had not funded Lockheed Martin to create a DMSMS process and had not developed a DMSMS Program Management Plan; causing a significant cost risk to the program. However, according JPO, JPO was in the process of funding a DMSMS program.

We also identified that JPO did not establish definitive exit criteria for the block 2A Air System Test Readiness Review, reducing the probability that the system is ready to proceed into formal test. JPO systems engineering and risk management plans require contractors to continuously assess the F-35 Program risks. However, JPO was not reviewing and documenting program risks during the Program Management Advisory Board meetings or the risk-level management reviews. Without active participation in systems engineering, risk management, and lifecycle logistics planning for the F-35 Program, JPO cannot ensure that all program requirements will be met.

Lockheed Martin Assessment Summary

Our assessment of Lockheed Martin's quality management system, processes and procedures indicated a lack of discipline in complying with AS9100 requirements. This will result in nonconforming hardware, less reliable aircraft, and increased cost.

Manufacturing planning and process qualification were not at the level commensurate with current and planned production levels. In general, documentation contained inaccurate and incorrect verification steps and lacked sufficient detail to provide adequate work instructions. This indicates that processes remain immature and that assembly instructions require immediate updating.

Lockheed Martin's management of requirements; including those flowed down to suppliers in the areas of design, configuration management, software, and FAI; were not always clearly defined, approved, maintained, and verified for compliance. In addition, the requirements provided conflicting direction. Without clear and accurate requirements, Lockheed Martin cannot ensure that flight hardware meets F-35 Program requirements.

Finally, Lockheed Martin was not committed to FOD control. Workers were in the assembly areas with expired FOD certification, and discipline was generally lacking in FOD-control and FOD-critical areas. The inspection team noted substantial FOD in and around the aircraft; these FOD deficiencies continued even after Lockheed Martin management shut down the line twice to correct noted deficiencies during the OIG assessment. An ineffective FOD program can result in damage to F-35 aircraft and is a safety flight issue.

Northrop Grumman

(El Segundo and Palmdale, California)

Northrop Grumman is one of Lockheed Martin's principal subcontractors. Northrop Grumman manufactures the center fuselage and weapons bay doors of the aircraft. The manufacturing operations are divided between two manufacturing facilities: El Segundo and Palmdale, California. The engineering team is located at the El Segundo facility. That facility also produces the composite skins and weapons bay doors. The Palmdale facility develops and integrates the center fuselage component; including the tail cap antenna, composite panels and covers, in-flight operable doors,

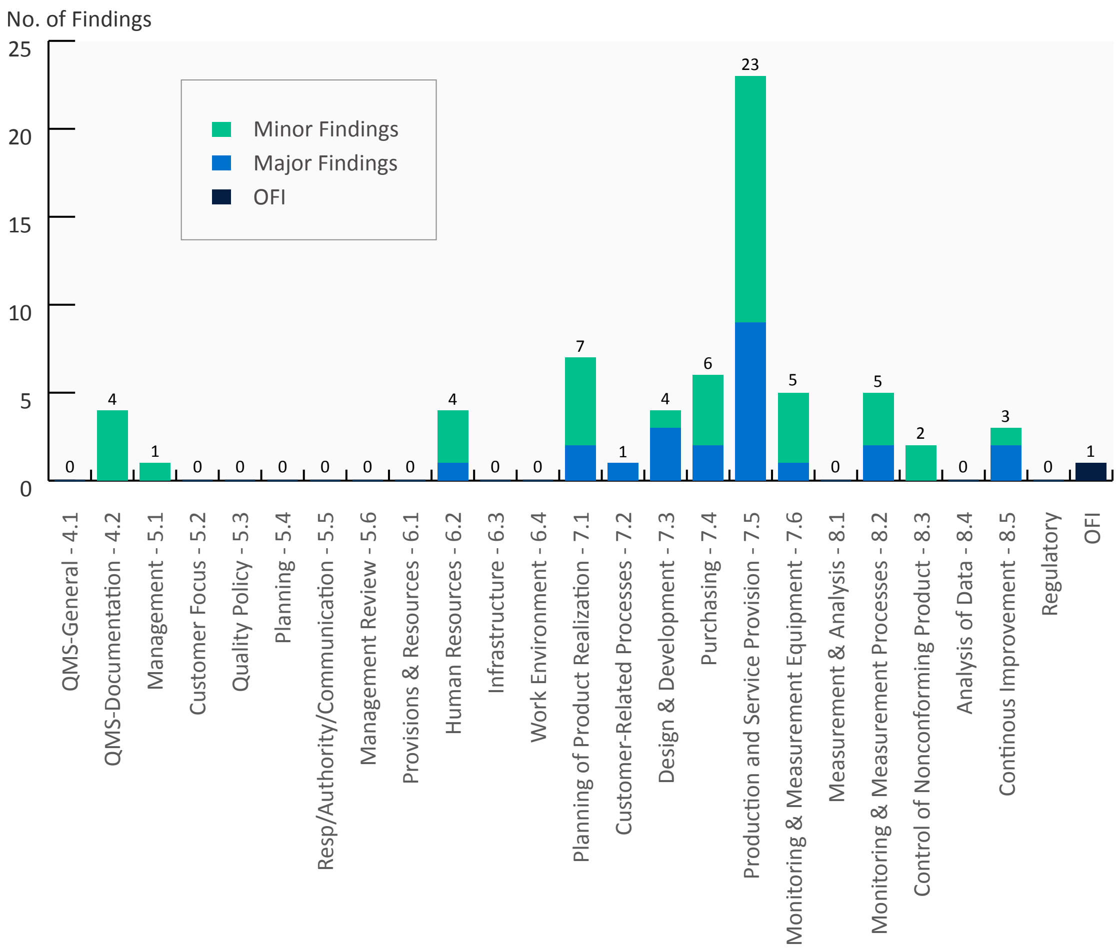


Figure 5. F-35 Center Fuselage at the Palmdale, CA, Manufacturing Facility
Source: Photo courtesy of Northrop Grumman

arresting gear system, weapons bay door drive system, fire protection system, and multiple mission systems provided by its suppliers. Figure 5 shows the center fuselage on the integrated assembly line at the Palmdale facility.

Our assessment of Northrop Grumman resulted in 66 findings that identified deficiencies in Northrop Grumman's implementation of the AS9100 Quality Management System. As part of our assessment of Northrop Grumman, we wrote several findings regarding the effectiveness of Lockheed Martin requirements flow down to suppliers. Figure 6 provides the Northrop Grumman findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.

Figure 6. Northrop Grumman Findings



Planning of Product Realization (7.1)

Our assessment documented several deficiencies in the area of Product Planning and Realization. We noted that the temperature and relative humidity parameters in the automated paint system were not programmed to required specifications, and operators changed the parameter limits without management approval. In two other instances, the required torque value was not included in the process work instructions. Specifically, the torque paint application and special hole finish verification were not included in the process work instructions. A third finding documented a similar deficiency with adhesive application and cure times. We could not determine if these required parameters had been met or verified. Product reliability and repeatability relies on explicit process work instructions, and Northrop Grumman needs to assess the risk to and impact on delivered hardware resulting from these deficiencies.

Customer-Related Processes (7.2)

Customer Communication (7.2.3). Northrop Grumman did not provide DCMA with adequate access to Northrop Grumman command media or other enterprise systems to effectively administer its delegated contract oversight functions. Specifically, DCMA Palmdale requires access to corrective and preventative action databases, internal audits, metrics, policies, processes, and procedures.

The lack of access to program information prevented DCMA from effectively administering Northrop Grumman Palmdale contracts as required by the Federal Acquisition Regulation/Defense Federal Acquisition Regulation Supplement and monitoring JPO's expectations for cost, schedule, and performance.

Design and Development (7.3)

Design and Development Planning (7.3.1). We documented deficiencies with the software development processes for engineering software releases. Northrop Grumman released five engineering software versions of the mission systems software to Lockheed Martin without a formal documented product test, including the test plan for changed requirements and the test results. Instead, Northrop Grumman's practice was to test software releases only at the unit/module level. Northrop Grumman stated that software test performed at the unit level versus assembly level are done informally; therefore, no records were retained. In addition, the Software Safety Engineer was not actively participating in software product evaluations to review and assess safety assurance-level

requirements as required by the Software Development Plan. The assessment reviewed four software product evaluations; however, records indicated that the Software Safety Engineer had participated in only one of four evaluations.

Software testing at the unit/module level creates an integration risk because modular testing may not have been sufficient to verify software interoperability issues.

Purchasing (7.4)

We cited deficiencies in Northrop Grumman's flow down of supplier requirements and supplier submittal of contract deliverable data. Some purchase orders showed incorrect part or material revision information. In one example, the purchase order for carbon fiber material did not include specification revision information. Northrop Grumman relied on the composite material supplier to determine the correct version of the ordered products. Receiving inspection personnel could not verify the correct versions of parts or materials received due to the lack of part revision information on the purchase order. Therefore, the material was accepted and used in production without engineering approval or verification of correct version. Without revision information in purchase orders, receiving inspection personnel cannot verify that correct versions of parts or materials are received, and that incorrect parts and materials are not introduced into production.

We sampled several of Northrop Grumman's automated purchase orders and found that the purchase orders did not include the means to identify specification revisions on raw material receiving reports. Because of the significance of this finding, Northrop Grumman initiated an in-depth investigation to determine the impact to delivered hardware. Other findings documented that Northrop Grumman was not following its supplier management procedures. Suppliers rated with a "red," or high-risk supplier scorecard rating were still allowed to conduct self-inspections of material shipped to Northrop Grumman. Northrop Grumman should have imposed additional inspections to ensure material conformity.

Production and Service Provision (7.5)

Control of Production and Service Provision (7.5.1). Our assessment found evidence of incomplete manufacturing and quality assurance records and a lack of adherence to released process procedures. A major finding noted that Northrop Grumman did not ensure that all quality assurance verification operations were completed. Northrop Grumman did not complete several quality inspection/verification steps in shop orders for manufacturing the Integrated Power Package Door Mechanism and the Collector Panel.

We noted that Northrop Grumman personnel did not follow released work instructions. The operators were not following the process work instruction for setting the composite cutting blade depth prior to the cut. The operator set a depth that did not agree with the work instruction. In another example, during center fuselage buildup operations, fuel sealant had been applied to incorrect areas. The operator stated that the area sealed was no longer a "stay out zone" on the hardware; however, the work instructions had not been updated to reflect engineering's agreement to the change. In addition, two records documenting that the sealant application on several CTOL tail fins had not been completed. Our assessment identified several more manufacturing deficiencies.

- Composite cumulative adhesive shelf-life times were not recorded for some composite materials.
- The liquid shim application process was not in compliance with documented procedures.
- Drill bit life was not being tracked. Drill bit life should be tracked to ensure dimensional compliance.

Production Process Verification (7.5.1.1). We noted that Northrop Grumman had not performed or completed FAIs on all F-35 center fuselage variant assemblies. A review of Northrop Grumman's FAI status and schedule data noted that FAIs were initiated but never completed for LRIP 4 variants. Northrop Grumman discontinued performing FAIs in accordance with Lockheed Martin's direction as stipulated in the July 20, 2011, released FAI plan. The Lockheed Martin FAIs Plan is in direct conflict with the SOW. Completion of FAIs on the F-35 center fuselage variant assemblies is essential to verify that the production process is capable of producing assemblies that meet requirements.

Control of Production Equipment, Tools, and Software Programs (7.5.1.3). Our assessment noted deficiencies with the validation and control of numerical software programs. More than 75 percent of the F-35 composite numerical control machining programs were in an "unproven" state with no traceability established between the numerical control program and the part produced. Specifically, the automated machinery screen used by the operator to select the file for machining listed numerous files, some listed as "proven," others as "unproven." Numerous files designated as "unproven" could be inadvertently selected to generate the exact same part number. A similar condition existed for the measurement programs used to validate the parts produced on the precision milling machine. These findings represent a significant risk that either unproven files or files not designated as the latest approved configuration could be selected and used in producing the product.

We documented tool control deficiencies. The radio frequency identification system was incapable of tracking tool location. It incorrectly identified tools as missing or in another location; allowing similar tools to be returned to incorrect locations. In addition, Northrop Grumman personnel did not always trace missing tools as required by procedures. Several other findings noted deficiencies with the identification, storage, and application of tooling. Ineffective tool control can lead to quality issues such as the wrong tools used during assembly, lost tools, and insufficient visibility in calibration measurement. It can also lead to field returns caused by uncalibrated equipment.

Preservation of Product (7.5.5). Our assessment identified deficiencies with the control of limited-life materials. Northrop Grumman's process for controlling shelf-life materials did not ensure that all materials used on the manufacturing floor were within their useful life. Expired sealant material was used on flight hardware, and elastomeric filler was labeled with incorrect shelf life expiration dates. Also, 17 tubes of expired product were provided to the production floor. We immediately notified Northrop Grumman, which initiated action to recall the nonconforming materials and began the material review board process for the affected parts. An additional finding noted that material shelf life information was not always identified on transfer containers, leading to a loss of traceability to its useful life. Using expired materials could affect structural integrity of the final product.

FOD procedures were not being followed in production floor areas designated as category 1 FOD-critical areas. Specifically, a category 1 FOD-critical area requires heightened FOD awareness including cordoning off the area, displaying FOD-critical signs, and implementing sign-in/sign-out logs and tool control logs. In one instance, crane operators in a FOD-critical area had not recorded themselves or their tooling into the area. All tooling brought into a FOD-critical area are required to be documented on a FOD-control card. In another instance, personnel were performing a close-out operation on an inverted fuel tank and side skins in a category 2 FOD-control area, but this operation should have been performed in a category 1 FOD-critical area. The purpose of a FOD program is to ensure that loose hardware is accounted for, such as bolts or nuts, preventing the puncturing of tanks, hydraulic lines, or damaging other sensitive components during aircraft operation.

Control of Monitoring and Measuring Equipment (7.6)

We noted Northrop Grumman was providing extension of calibration intervals without proper evaluation and engineering approval. A date extension was provided on a digital pressure gauge with a poor calibration history even though two out-of-tolerance conditions were documented on this item. Calibrated equipment with a history of out-of-tolerance conditions should have their calibration interval shortened, not extended.

Other findings addressed calibration deficiencies such as the use of incorrect calibration procedures and ambiguous humidity requirements in the calibration lab. Without a disciplined and controlled calibration system, the accuracy and integrity of calibrations performed is uncertain. This may result in hardware being processed and accepted because the discrepant test and measurement equipment masked an out-of-tolerance condition.

Monitoring and Measurement (8.2)

Monitoring and Measurement of Product (8.2.4). We found that Northrop Grumman did not use the correct test system configuration or software configuration for performing electrical test methods on composite parts and material. Another finding documented that quality assurance personnel did not record or witness production measurements and test results on the integrated assembly line. We also noted that work instructions did not require quality assurance personnel to record nut plate push test results and rivet flushness measurements; therefore, no test values were recorded and test verification could not be done. Without proper test set-ups and quality assurance personnel verifying critical measurements, Northrop Grumman cannot be certain whether all the requirements were tested and verified.

Continuous Improvement (8.5)

Corrective Action (8.5.2). Our assessment team noted that the Northrop Grumman corrective action system for in-house operations and suppliers was ineffective. Northrop Grumman was in the process of transitioning into a new software problem reporting tool; however, neither the legacy tool nor the new tool adequately captured the root cause and analysis of software nonconformance. We also noted that Northrop Grumman did not conduct root cause analysis for software internal audit findings and did not approve corrective action plans in a timely manner. Root cause analysis and timely corrective actions prevent future nonconformances and marginal products from being fielded.

Lockheed Martin Program Management at Northrop Grumman

Our assessment documented several major findings related to Lockheed Martin's flow down of requirements to Northrop Grumman in the areas of Software Traceability, Software Development, Software Corrective Action, and FAI.

Lockheed Martin did not maintain mission systems requirements traceability to the software-level requirements. The Lockheed Martin Dynamic Object Oriented Requirements System (DOORS) requirements database contained about 300 orphan requirements for missions systems. An orphan requirement is one that is not derived from or traceable to top-level system requirements. Lockheed Martin identified this deficiency in July 2010; however, it did not document or implement the root cause and corrective action.

Our review of the JSF Program Air System Block Plan showed that the plan had not been updated since August 13, 2008, and does not reflect current block planning defining Air Systems capabilities for the F-35 Program. As a result, there is no authoritative document defining current and planned F-35 software capabilities.

Northrop Grumman Assessment Summary

Our assessment found deficiencies at both the El Segundo and Palmdale sites. Deficiencies at the Northrop Grumman, El Segundo, site were primarily in the area of design and purchasing. Northrop Grumman's practice of performing unit/modular software testing without documenting the results creates significant concerns regarding requirement verification and interoperability. Without adequate design evaluation and test of mission system software, Northrop Grumman cannot ensure all software system and safety requirements have been met. Purchase orders lacked material version information to ensure that material was procured to the required specifications. After bringing this deficiency to their attention, Northrop Grumman initiated an investigation to determine the impact on the hardware.

Our assessment of the Palmdale facility noted several deficiencies, most of which were attributed to the creation of a new integrated assembly line. Documentation of processes and procedures used in manufacturing had not reached the expected maturity. Procedures did not reflect the actual operation, were missing required detail, and required additional proofing for accuracy. Northrop Grumman had implemented a radio frequency identifier system for tool control; however, it was ineffective and did not provide the necessary accountability and control warranted for a complex production and assembly area.

BAE Systems

(Samlesbury, United Kingdom)

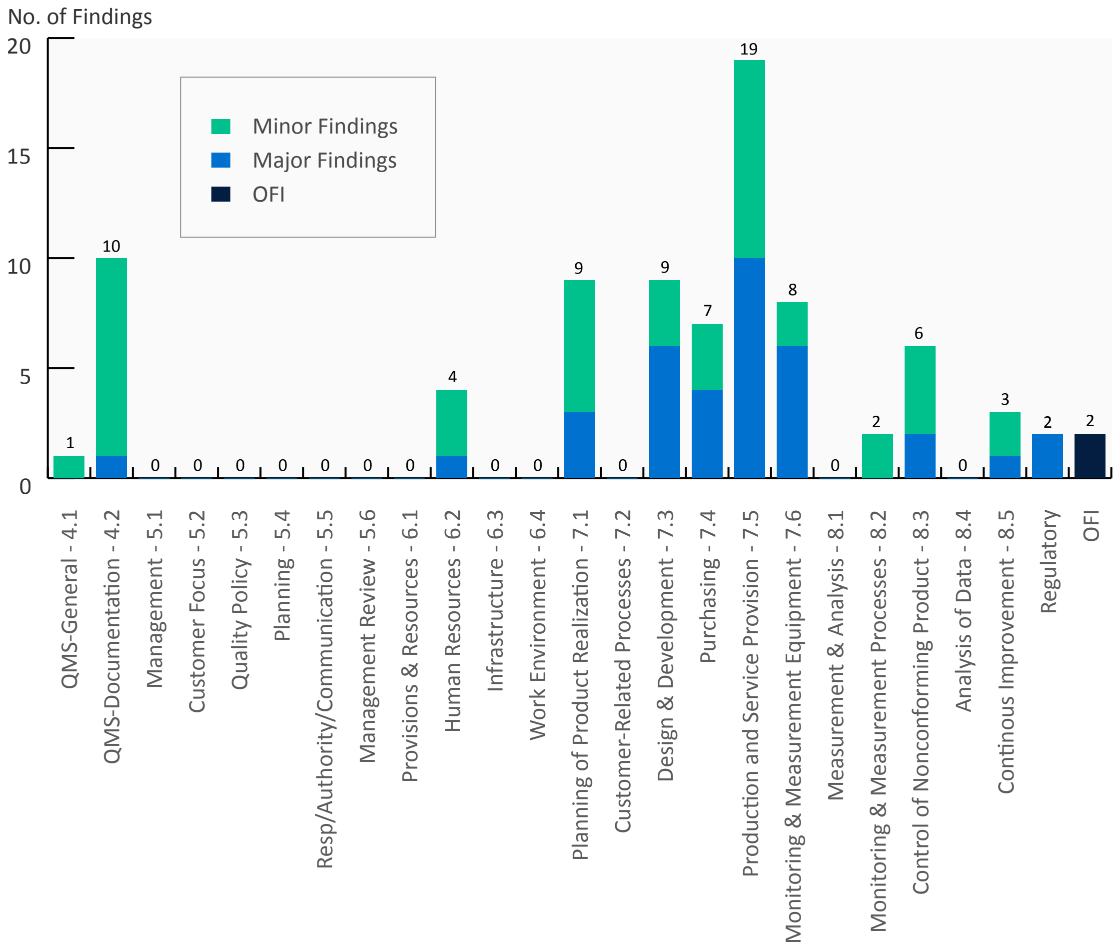
BAE Systems is Lockheed Martin's other principal subcontractor. BAE manufactures the aft fuselage and the carrier variant wing-fold system; including critical items such as the horizontal tails and vertical tails. Additionally, BAE, as one of the major software suppliers for the F-35 aircraft, is responsible for developing fuel system software, navigation and display software, vehicle system prognostics and health manager software, and off-board mission support software. Figure 7 is an image of the aft fuselage on the manufacturing floor at BAE.



Figure 7. BAE Aft Fuselage
Source: Photo courtesy of BAE Systems

Our assessment of BAE resulted in 82 findings that identified weaknesses in BAE's implementation of the AS9100 Quality Management System. Additionally, Lockheed Martin had several deficiencies in requirements flow down to BAE. We also identified issues related to JPO and DCMA oversight. Figure 8 provides BAE findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.

Figure 8. BAE Findings



Documentation Requirements (4.2)

Control of Documents (4.2.3). We identified several production documents that were not under configuration control. Examples of nonconfiguration controlled procedures and/or documents available for use include: chemical treatment, paint identification, machining health and safety plan, control of heat treatment, and bore-cutting tool and lubricate.

BAE updated the F-35 quality assurance plan for LRIP 4 and 5, but did not submit the documents to Lockheed Martin for approval. Production process documentation not approved or under revision control included the following checklists: daily production verification, first article verification, and production process verification. Controlling such documentation creates the means to ensure each assembly is exact and conforming to requirements.

Human Resources (6.2)

Competence, Training, and Awareness (6.2.2). BAE lacked discipline in the areas of employee training requirements, recertification, and training records. Skills matrices did not always identify the training required for each operator to perform a particular manufacturing process. For example, within building 355, no one had completed training competency in any of the required technical skills for the following critical processes: press operations, friction sawing, part marking, tungsten inert gas welding, automatic grit blast machining, and radial arm drilling. Many of the personnel lacking training were responsible for manufacturing fracture-critical hardware. In addition, we found in the other manufacturing facilities that BAE had not established performance criteria to evaluate employee competency. We also found that BAE did not have a recertification program for wire harness repair.

A training and certification program, to include control of training records, is critical to ensure that personnel manufacturing and inspecting hardware are proficient to prevent nonconformances. BAE's lack of a disciplined training program is a significant concern to the production of F-35 hardware.

Planning of Product Realization (7.1)

Configuration Management (7.1.3). BAE suppliers were not submitting minor changes to BAE for review and approval as required. For example, Honeywell, a BAE supplier, approved an engineering change request for the F-35 Life Support System without Lockheed Martin or BAE approval. Another BAE supplier, Ametek, approved an engineering change order for coating painting processes without BAE approval.

The assessment also noted that BAE suppliers were not submitting configuration status accounting records or reports that provide the "as-built" versus "as-designed" configuration. For example, Honeywell did not provide a configuration status accounting report for products delivered during LRIP 4 and LRIP 5. Additionally, Goodrich Actuation also had not provided a configuration status accounting report for LRIP 5 delivered products.

BAE did not have schematics/drawings to define the Fuel Management System software test stand and did not have the set-up/take-down procedures or troubleshooting guidelines necessary to maintain the test stand configuration. BAE also did not conduct software certification of the software test stand, as required prior to software qualification testing.

Controlling engineering changes and providing adequate configuration status accounting of product is essential to ensure the approved configuration replicated correctly every time. Failure to maintain the required configuration management disciplines increases program performance, cost, and schedule risks.

Design and Development (7.3)

We identified several major deficiencies in the areas of program management, configuration control, and testing. In the area of software development, BAE was working to an outdated version of the F-35 mission systems software development plan (SDP),[7] was not maintaining the software design document (SDD) for the vehicle system fuel management system, and was working to unapproved software regression test procedures. In the area of hardware development, BAE was not approving all design review plans for the F-35 Program.

Design and Development Planning (7.3.1). BAE developed F-35 software without using the latest Lockheed Martin approved SDP. According to the contract, BAE is required to follow the latest software design plan released by Lockheed Martin. BAE was developing software to the Mission Systems Software Development Plan revision C (dated September 15, 2007), although the current approved and released revision is revision E (dated August 14, 2012). Inadequate flow down of software development requirements could affect aircraft performance and safety requirements.

Design and Development Outputs (7.3.3). BAE's software requirements specification (SRS) for the vehicle system fuel management system was revised 15 times over a 5-year software development period; however, the SDD was not updated with these changes. For example, the SDD was not updated to reflect corrective actions for fuel management system software trouble reports that were in the revised SRS. Software design decisions and requirements changes should be captured in the SDD; otherwise, the software design baseline may not meet system performance or safety requirements.

Design and Development Review (7.3.4). We noted that the life cycle management design review plan had not been approved by the project engineering manager and the design review chairman. Approval of the plan certifies that the objectives and exit criteria fulfill the objectives of the review. If the objectives and exit criteria in the design review plans are not certified, there is no assurance that performance requirements will be realized.

[7] The SDP describes a developer's plans for conducting a software development effort. The term "software development" is meant to include new development, modification, reuse, reengineering, maintenance, and all other activities resulting in software products. (DAU)

Design and Development Validation (7.3.6). We documented that BAE was using an unapproved regression test procedure and conducted incomplete regression tests. Regression testing is important because it provides confidence that changes do not degrade functionality. One finding documented that there was no approved regression test procedure for the Prognostics and Health Management software release. Additionally, the functional test description for the Prognostics and Health Management software requires 35 test runs, but the test report showed that BAE partially conducted only 9 of the 35 required tests. In addition, in the software requirements verification matrix, four requirements were determined "unverifiable by test" and required verification by analysis; however, the analysis was not performed.

Purchasing (7.4)

BAE's flow down of requirements to suppliers was insufficient to ensure that the delivered product meets all the necessary quality assurance and technical requirements. The assessment documented several findings citing inadequacies in BAE flow down of supplier requirements and suppliers submittal of contract deliverable data.

Purchasing Information (7.4.2). BAE issued several purchase orders to suppliers that contained inaccurate and inconsistent requirements. For example, two purchase orders cited the wrong SOW, and three purchase orders did not specify Government-furnished equipment by part number.

BAE also flowed down incorrect configuration management requirements to suppliers. In accordance with Lockheed Martin direction, the "Configuration Management Requirements for F-35 Suppliers and Subcontractors," should have been flowed to suppliers in purchase orders supporting LRIP and follow-on contracts. However, an earlier requirements document, titled, "F-35 Joint Strike Fighter Program, Configuration Management Plan," had been flowed to suppliers, but did not contain the necessary supplier configuration management responsibilities and requirements. Without proper flow down of technical and quality assurance requirements, BAE cannot ensure that their products meet performance, reliability, and other system requirements.

Verification of Purchased Product (7.4.3). BAE was not verifying that its suppliers were submitting critical supplier data deliverables such as acceptance test procedures (ATPs), quality assurance plans, and configuration management certifications.

Production and Service Provision (7.5)

Control of Production and Service Provision (7.5.1). We documented that BAE was not following process inspection procedures, completing manufacturing and quality assurance records, or complying with tool control processes. BAE standard procedures require that inspectors verify and record that operations are complete. However, in several instances, the inspector did not record completion of the operations. For example, we documented that quality assurance personnel had not verified epoxy primer, urethane topcoat, and abrasion-resistant coating processes. In another case, there was no indication that inspectors had completed buy-off of the water break test (ensures that the surface is properly prepared prior to bonding) on the tail-hook door and aft section.

Several procedures did not contain adequate detail or requirements to control the process. For example, specification requirements for the application and mixing times for the epoxy primer and topcoat were incorrectly identified on the paint shop process documents. As a result, actual mix times recorded in manufacturing process documents did not meet the specified requirements.

We found evidence of incomplete manufacturing and quality assurance records. In 15 instances, cleaning and cure details were not recorded in the mix log books. We found records with insufficient details for paint pot life, mix time, and touch-up processes. Mix times and pot life details are essential to ensure that material properties meet specification requirements prior to application. The failure to document manufacturing and inspection operations can lead to incomplete work, loss of traceability, and nonconforming products.

Production Process Verification (7.5.1.1). A major finding noted that BAE had not performed or completed FAIs on all F-35 details, subassemblies, and assemblies as required by Lockheed Martin supplier requirements and BAE internal instructions. For example, 11 subassembly FAIs were not conducted and three subassemblies had failed the initial FAI. A corresponding major finding was directed to Lockheed Martin for flowing down conflicting FAI requirements. Successful completion of FAIs on F-35 details, subassemblies and assemblies is one of the criteria for LRIP; therefore, BAE's processes do not reflect that criterion.

Control of Production Equipment, Tools, and Software Programs (7.5.1.3). The assessment identified several major deficiencies documenting the inadequate control of manufacturing tooling, jigs, and fixtures. Operators applied an unapproved steel epoxy stick in the incorrect location to hold two parts on the aft closeout rib in position

for machining operations rather than using the specified tooling. We found that BAE personnel were not monitoring tool wear of cutting tools in the aft fuselage assembly in accordance with their production work instructions. To prevent quality defects, the maximum specified use for a drill bit was 50 drilled holes; however, operators were not tracking the number of times a drill bit was used.

We documented systemic issues with the storage, inventory, and accounting of tooling. Tools were often unaccounted for and not in their correct locations as designated by the work cell tool inventory sheets. A major finding documented that BAE personnel did not perform visual, functional, and dimensional tool cycle checks on the final assembly tool fixture as required. Failure to control manufacturing tooling can lead to the use of discrepant, damaged, or incorrect tooling.

Identification and Traceability (7.5.3). We documented that inventory lists located on carts throughout the factory were inaccurate. We also found hardware commingled, and in some cases, improperly identified. As a result, positive part identification and control through the assembly process was not always evident. Because parts are manufactured for a specific airframe and are not readily interchangeable, failure to maintain traceability and identification of those parts results in interchangeability issues, nonconformances, and unnecessary rework or scrap.

Preservation of Product (7.5.5). The assessment documented numerous examples of limited shelf-life materials (LSLM) improperly labeled, tracked, and controlled. For example, BAE personnel used expired Click Bond adhesive material in the manufacture of vertical and horizontal tail assemblies. Other adhesive materials labeled with improper expiration dates were available for use. In addition, a bottle of expired alodine material was used on the production floor in the carbon subassembly area. Shelf-life material that is not properly labeled or controlled can lead to the use of expired materials in production. Use of expired shelf-life material compromises the assurance that its material properties will satisfy the intended requirements and the integrity of the assembly.

Control of Monitoring and Measuring Equipment (7.6)

BAE was not controlling calibration laboratory processes to meet established requirements. BAE was operating two calibration laboratories, but neither laboratory was accredited to meet ISO/IEC (International Electrotechnical Commission) 17025, "General Requirements for the Competence of Testing and Calibration Laboratories," as stipulated by BAE's internal procedure and a Lockheed Martin requirement. In addition,

several calibration procedures in the Test Instrumentations Laboratory did not address all requirements and criteria required by American National Standards Institute (ANSI) Z540, "Requirements for the Calibration and Measuring and Test Equipment." For example, the calibration procedures for temperature sensors and field test instrumentation did not address measurement ranges and tolerances for the item to be calibrated, minimum performance requirements, and criteria and requirements for calibration. Moreover, BAE did not have procedures to calculate the uncertainty of measurements for calibrations performed or a calibration procedure for furnaces or ovens.

BAE was not following its internal procedures for the tagging and removal of expired monitoring and measurement equipment. Numerous examples of equipment with calibration deficiencies were found throughout the facility. Deficiencies included out-of-calibration torque wrenches, vernier calipers, and a surface plate. Furthermore, torque wrenches were used for verification outside of their calibrated capability. In addition, BAE was not assessing the effect of out-of-tolerance equipment used on production hardware. In summary, the number of tool control and calibration deficiencies leaves uncertainty in BAE's product processing and acceptance.

Measurement, Analysis, and Improvement (8.0)

Control of Nonconforming Product (8.3) and **Corrective Action (8.5.2).** BAE is closing material review board documents without confirming effective and meaningful corrective action. Specifically, four out of ten material review board dispositions for nonconformances were closed without implementing the specified corrective action. In another finding, BAE did not submit all material review dispositions to the onsite DCMA representative for concurrence. Specifically, a waiver/deviation for the vertical tail substructure included both nonstandard repairs and use as is dispositions without any evidence of submittal to the DCMA representative for required approval.

The supplier corrective actions process did not always ensure suppliers responded to corrective action requests within the required time period. For example, 21 of 63 supplier corrective action request forms were past due by as much as 200 days. Furthermore, the supplier corrective action data were not accurately maintained. The supplier electronic corrective action database identified several supplier corrective action requests as closed; however, a sample review of the documentation indicated the status as open. Effective review and verification of material review board dispositions and associated corrective actions are necessary to correct and prevent nonconformances.

Lockheed Martin Program Management at BAE

We reviewed the effectiveness of Lockheed Martin program management and wrote seven findings. Lockheed Martin did not communicate to BAE that the latest software development plan was revision E, released on August 14, 2012; thus, BAE was developing JSF Mission Systems Software to revision C, dated 2007. The difference between the C and E revision could have a significant impact on functionality and performance.

In another finding, the F-35 Air Systems Software Development Plan requires that each product-level software development plan include plans for software maintenance. However, the Lockheed Martin approved software development plans for utilities and subsystems, prognostics and health management, ejection seat sequencer, boost/transfer pump controller, and life support system did not include the required software maintenance section. As a result, there is no assurance that software released is maintainable after delivery.

Lockheed Martin's FAI plan conflicts with the AS9102 requirements flowed down to BAE in the SOW, resulting in BAE not performing FAIs on major assemblies and subassemblies. Failing to perform FAIs in accordance with AS9102 could result in the inability to achieve process stability and successfully meet program production rate goals. The lack of process stability could also result in increased costs resulting from discrepant hardware and/or the need to perform additional product conformance verification to ensure engineering requirements.

Lockheed Martin did not flow down the correct quality management system requirement and the correct nonconforming material retention requirements. Additionally, Lockheed Martin did not specify the delivery requirements for the Counterfeit Parts Prevention and Control Plan; therefore, BAE did not produce a plan as required by contract. The Lockheed Martin configuration management plan imposed on BAE identifies additional requirements for BAE to follow; however, several of those references and the processes were no longer valid. Flow down of current and correct requirements to suppliers is essential to ensure delivered products meet program requirements.

Joint Program Office Oversight at BAE

JPO did not flow requirements for a CSI program to Lockheed Martin; therefore, BAE did not implement the required processes to ensure safety of flight.

DCMA Oversight at BAE

The DCMA UK was not reviewing BAE classifications and dispositions of all minor variances, nor participating in or reviewing the BAE Material Review Board actions as required by its LOD. BAE processes an average of 20 minor variations a day; however, as agreed to with BAE, DCMA reviews only about 10 percent of these, or 40 variances a month. In addition, DCMA UK had not delegated the responsibility for review of minor variances to DCMA office located at BAE suppliers. Government oversight ensures that engineering evaluations and corrective actions occur.

BAE Systems Assessment Summary

The software tests review provided little confidence that software was fully tested. There was also inadequate communication and requirements flow down from Lockheed Martin to BAE, leading to software configuration management gaps.

Supplier management practices failed to consistently define technical and quality assurance requirements in purchase orders, ensure supplier corrective actions were completed within process timeframes, and verify supplier data submittals were in accordance with purchase orders. BAE must ensure all technical and quality assurance requirements are properly included in contracts and implemented by their suppliers to meet cost, schedule, and performance goals.

In addition, improved production discipline is required. The assessment showed that additional process discipline is required to ensure conformity to end-item requirements. Personnel were relying on their knowledge of the design and production processes, rather than following documented processes. We found 14 examples of documentation that lacked essential detail to define, implement, and capture production processes.

Tool control, maintenance of precision tools, and calibration needs attention. Uncontrolled and unaccounted for tools were prevalent throughout the production facility. Additionally, the calibration system had significant deficiencies. A disciplined calibration program is essential in determining the performance and acceptance of product.

L-3 Display Systems

(Alpharetta, Georgia)

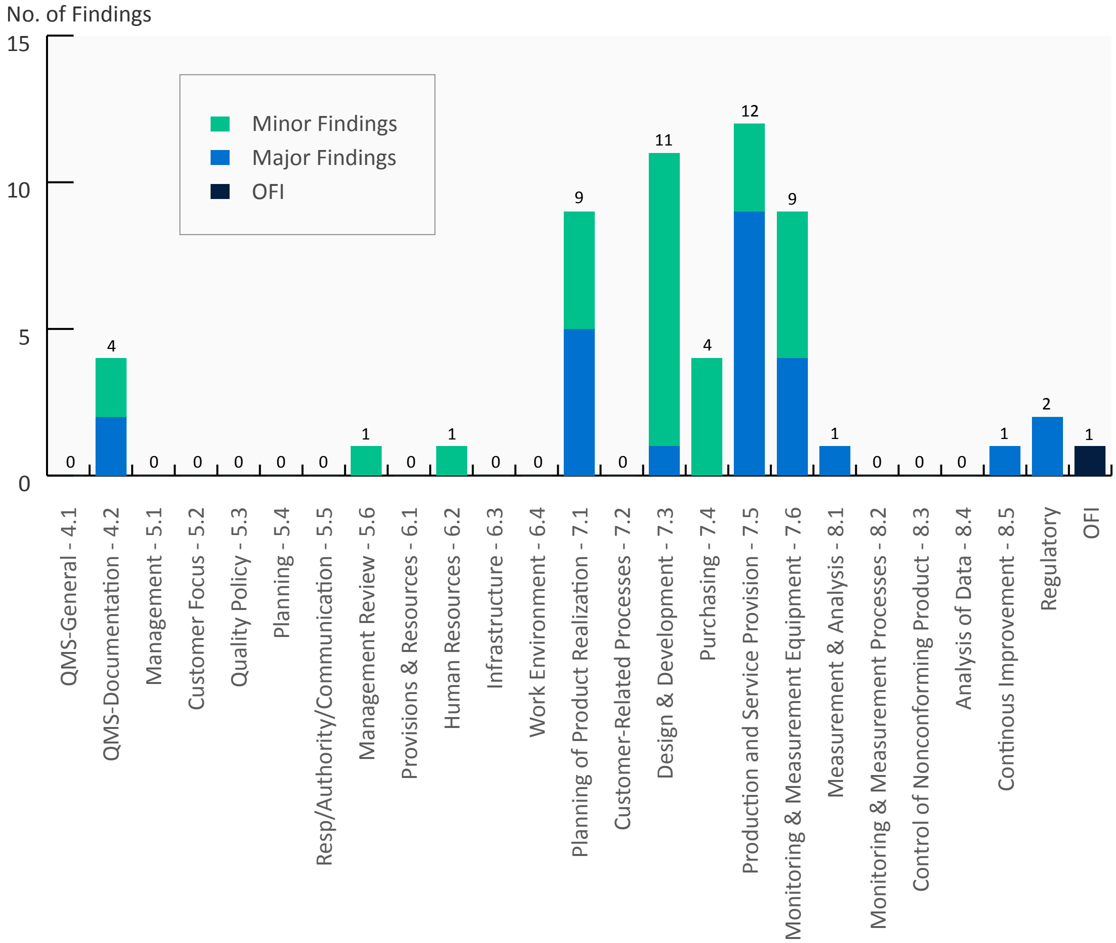
L-3 Display Systems (L-3), Alpharetta, Georgia, a division of L-3 Communications Corporation, is a Lockheed Martin subcontractor that manufactures the Panoramic Cockpit Display (PCD) for the F-35 Lightning aircraft. The PCD, Figure 9, performs significant functions such as providing pilot flight navigation and sensor information, communication, and threat situational awareness. The PCD consists of two major components, the Display Unit (DU) and the Electronics Unit (EU). The DU is the interface between the pilot and the aircraft situational awareness systems while the EU is the electronics package capturing and providing data to the DU from aircraft systems.

Figure 9. L-3 Communications Panoramic Cockpit Display.
Source: Image courtesy of L-3 Display Systems



Our assessment of L-3 resulted in 56 findings that identified deficiencies in L-3's implementation of the AS9100 Quality Management System. Figure 10 provides L-3 findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.

Figure 10. L-3 Communications Findings



Documentation Requirements (4.2)

Our assessment of L-3's document control system identified several findings with review, revision control, approval, and distribution of items such as internal procedures and manufacturing instructions. We found some documentation did not have management approval, were released without periodic review, had inaccurate revisions and dates, or document indexes that were not maintained. Check sheets used to define the buildup of circuit cards in the surface-mount technology assembly area were not controlled and there was no means to verify the latest revision. This lack of accurate, complete, and current documentation could adversely affect the ability of the F-35 Program to deliver products that meet customer performance requirements in accordance with schedule requirements.

Configuration Management (7.1.3)

Our assessment documented several findings pertaining to configuration management. We identified a lack of baseline technical documentation for L-3 DU and EU products. According to the L-3 product configuration documentation, a documented product baseline was required concurrently with the first production aircraft delivered in May 2011; however, this was not done. Similarly, an allocated baseline configuration was required for CDR closure, but it also was not done. A configuration baseline establishes a product's form, fit, and functional performance that is analyzed, tested, and characterized. Such a rigorous approach was lacking, and could result in additional product cost.

L-3's engineering change control process lacked discipline. L-3 incorrectly classified engineering changes that affect the form, fit, and function as "minor" changes when they should have been classified as "major." Major engineering changes require Lockheed Martin approval. For example, L-3 classified two changes as "minor" that increased the weight of the display interface circuit card assembly and weight of the touch screen by 85 percent and 62 percent, respectively. These changes affected product form, fit, or function and should be classified as "major" and not as "minor." We identified that L-3 implemented several "major" changes prior to receiving Lockheed Martin authorization. Incorrect classification of engineering changes and the implementation of engineering changes prior to authorization bypass the systems engineering review and approval cycle. Inadequate review of engineering changes will adversely affect product performance, quality, and reliability.

Design and Development (7.3)

We found that the electromagnetic interference (EMI) qualification for the PCD, EU, and DU did not meet the performance-based specification, frequency bandwidth requirement. The performance-based specification requires that radiated susceptibility testing be performed over a specific range of frequencies (10 KHz to 18 GHz) in accordance with MIL-STD-461E, "Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment." However, L-3 was performing testing in the range of 30 MHz to 18 GHz without engineering approval for the reduced frequency range. Although the EMI test report was comprehensive, the quality assurance review process failed to identify that a performance-based requirement was not being met. Additionally, according to the documentation, the EMI qualification test was completed without issues.

L-3 did not adequately review the F-35 PCD integrated system verification plan/procedures. The PCD Functional Test Procedure, Software Functional Test Description, and Requirements Verification Matrix had not been reviewed or dispositioned. We also found that Lockheed Martin, as the prime contractor, should have approved these documents but did not.

Product and Service Provisions (7.5)

Control of Production and Service (7.5.1). Quality assurance personnel did not verify several DU ATP luminance[8] requirements to the updated requirement. Specifically, black nonuniformity and red, green, blue, and white luminance nonuniformity were required not to exceed the value of 30 percent. L-3 indicated to Lockheed Martin that it could not reasonably meet the specification, so Lockheed Martin issued a variance allowing the value not to exceed 50 percent. Although Lockheed Martin granted requirement relief, the L-3 test procedure did not reflect the change, and quality assurance personnel did not verify the new requirement.

Production Process Verification (7.5.1.1). Our findings identified deficiencies with L-3's supplier FAI program. L-3 did not require all selected suppliers to perform FAIs. Specifically, the JSF contract provision for the LRIP 5 states that FAI requirements shall be flowed down to L-3 suppliers. Two purchase orders for suppliers, Ayesas and DDI Sales Corporation, required FAI on their product. However, the supplier did not perform FAIs, and L-3 accepted the hardware without suppliers demonstrating the capability to produce conforming products. As an example, we found a supplier FAI report containing several nonconformances that were not addressed, although L-3 had been accepting hardware from this supplier since 2008. Finally, L-3 was not maintaining all supplier FAI quality assurance records in accordance with contractual requirements. L-3's lack of systems engineering, regarding FAIs, creates uncertainty that components built in the future will conform to requirements.

Control of Production Equipment, Tools, and Software Programs (7.5.1.3). L-3 did not maintain EU and DU test stations to drawing requirements. Of the five test stations in operation, one test station did not have a released drawing package defining the equipment, equipment wiring, software, and verification of accuracy. Another test station had a released drawing but the test station was not configured in accordance to the released drawing. In addition, we could not find evidence that similar test stations

[8] Merriam-Webster dictionary defines luminance as: "the luminous intensity of a surface in a given direction per unit of projected area."

would produce comparable results. We found the method for performing correlation analysis among the test stations was undefined. Correlation studies should be performed to quantify the variability between multiple test stations used for final acceptance test.

Preservation of Product (7.5.5). Our assessment team identified four findings regarding the control of LSLM, FOD, and electrostatic discharge (ESD) processes and practices. We found LSLM items on the manufacturing floor not stored at the required temperature, improperly identified, or expired. Additionally, L-3 did not fully implement or follow its product protection program and requirements for FOD and ESD. DUs were stored on transport carts without adequate FOD and ESD protection. In addition, L-3 did not perform verification of the conductive flooring and constant wrist strap monitors in accordance with its ESD Compliance Verification Plan. This lack of preservation of product could result in reduced product quality and reliability.

7.6 Monitoring and Measurement Equipment

L-3 could not demonstrate adherence to calibration standards. The current Lockheed Martin purchase order requires L-3 to have a calibration program that meets one of the three industry standard requirements: ISO 10012-1, "Requirements for Measurement Processes and Measuring Equipment," ISO 17025, "General Requirements for the Competence of Testing and Calibration Laboratories," or ANSI Z540-3, "Requirements for the Calibration of Measuring and Test Equipment."

We found seven examples of out-of-calibration equipment still in use on the production floor or available for use. Four pieces of equipment were in the calibration area and not properly identified and segregated. Three others were available for use on the production floor with only one of the three tagged as out-of-calibration. L-3 could not provide objective evidence that an out-of-calibration piece of equipment was traceable to the flight units tested, as evidenced by evaluating three flight unit acceptance records. L-3's calibration and control system failed to provide adequate corrective actions. As an example, engineering personnel evaluated an out-of-tolerance photometer requiring the next four photometers to be evaluated to the internal lighting standard. We found no documentation or evidence that the evaluation had occurred.

L-3's dimensional final inspection methods and measurement equipment were incapable of verifying product conformance to drawing requirements. The ATP required the inspector to use "single-dimension vernier calipers" to measure a multi-dimension geometric parameter on the DU. However, this measurement equipment and method was incapable of measuring the required dimensions.

Our findings indicate that the systemic issues with the control of monitoring and measurement equipment could significantly affect measurement accuracy and/or quality assurance data used to determine product acceptance.

Lockheed Martin Program Management at L-3

We reviewed the effectiveness of Lockheed Martin program management because it is the prime contractor ultimately responsible to integrate L-3 products. We found that the performance-based specification for the aircraft PCD flowed down from Lockheed Martin to L-3 had incomplete, conflicting, and ambiguous system requirements. There were action items from CDR pertaining to the requirements that were not formally closed, leading to the document ambiguity. The Lockheed Martin corrective action system implemented at L-3 failed to effectively eliminate nonconformities and prevent their recurrence. Lockheed Martin accepted PCDs without L-3 having performed FAI and did not require L-3 to perform configuration status accounting for components delivered for LRIP units 1 through 5, that were previously delivered. Lockheed Martin is not approving or disapproving all major changes nor providing concurrence on the classification submitted by L-3, providing further evidence that Lockheed Martin was not sufficiently managing its suppliers.

DCMA Oversight at L-3 Communications

We found that DCMA Fort Worth, the prime DCMA office for the program, and DCMA Atlanta did not execute all responsibilities specified in the memorandum of agreement for the F-35 Program. DCMA Fort Worth delegated the administration of Government contract quality assurance of all F-35 parts produced at L-3 to DCMA Atlanta in a letter of delegation (LOD), with the requirement that Atlanta perform risk-based surveillance on high-risk components. During our review of DCMA Atlanta records, we found no evidence that surveillance was being conducted on F-35 products within the L-3 facility. Furthermore, DCMA Atlanta was not providing the prescribed reports requested in the LOD such as quality escapes, supplier risks, corrective action requests, and monthly Product Assessment Reports.

L-3 Communications Assessment Summary

We found deficiencies in most of the AS9100 Quality Management System disciplines. The most significant deficiencies highlight the lack of process discipline in implementation of Product Realization, which includes the following categories: configuration management, product verification, and monitoring and measurement equipment.

The implementation of L-3's configuration management system was inadequate and could lead to inconsistencies in product performance, functionality, and reliability. The L-3 DU and EU development program did not produce product configuration baselines prior to delivery of the first production unit. L-3 had incorrectly classified engineering changes that affected form, fit, and function, such as increases to weight and human interface constraints, and had not received Lockheed Martin approval for major design changes prior to manufacturing the product.

L-3's lack of process discipline in the area of product verification was particularly disconcerting. We noted systematic breakdowns in requirements verification, FAI, test station configuration, and preservation of product that raises questions about the integrity of the L-3 product. L-3 did not consistently verify that product acceptance test data met specified requirements and did not consistently review FAI reports. In addition, L-3 did not manage or maintain test station configurations. L-3 also insufficiently implemented LSLM, FOD, and ESD processes.

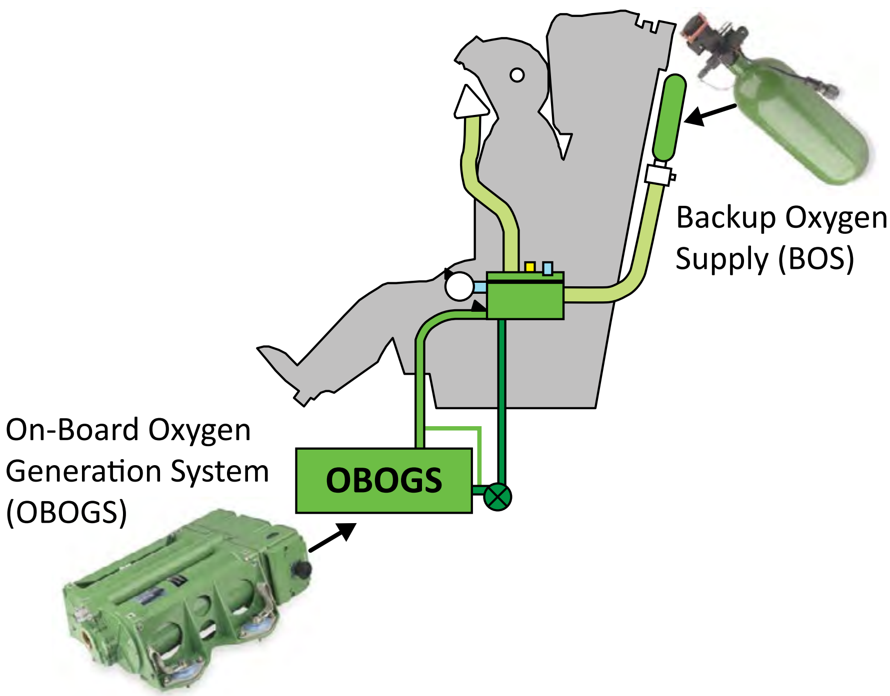
L-3 did not demonstrate adherence to calibration standards. L-3 did not ensure out-of-calibration equipment was identified and removed from the production floor. L-3's calibration system failed to recall flight hardware after discrepant test equipment was identified.

Honeywell Aerospace

(Yeovil, United Kingdom)

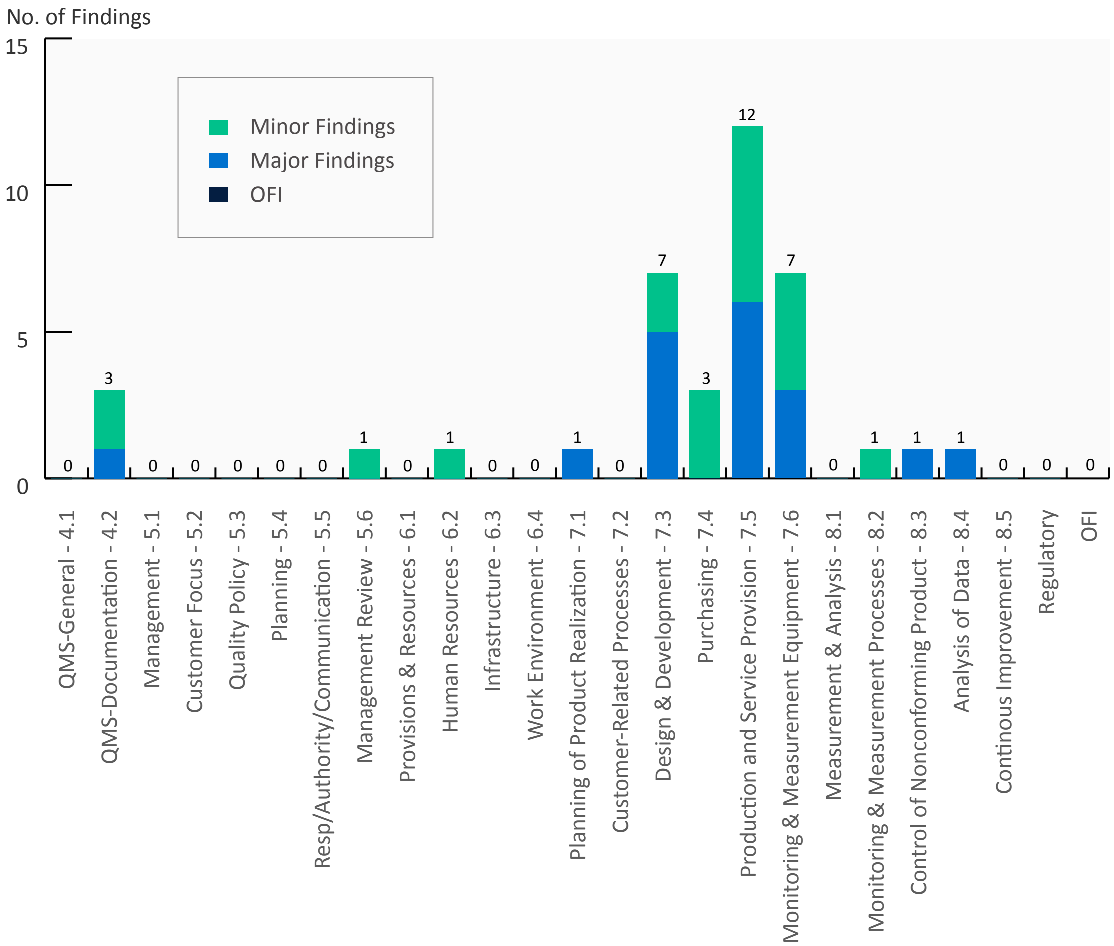
Honeywell is a subcontractor to BAE and a tier 2 subcontractor to Lockheed Martin. Honeywell manufactures the F-35 aircraft life support system, consisting of the On-Board Oxygen Generation System (OBOGS), Backup Oxygen System (BOS), and Service Connection Package. Figure 11 is a diagram of the Life Support System.

Figure 11. Diagram of the Life Support System.
Source: Image courtesy of Honeywell



Our assessment of Honeywell resulted in 38 findings that identified deficiencies in Honeywell's implementation of the AS9100 Quality Management System. Figure 12 provides Honeywell findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.

Figure 12. Honeywell Findings



Human Resources (6.2)

Competence, Training, and Awareness (6.2.2). The Honeywell training program was inadequate. Honeywell does not have an overarching procedure to govern the training requirements, training roles and responsibilities, and records retention requirements. The Human Resource Manager explained that although Honeywell delegated the various assembly floor training needs and records to the respective floor managers; in practice, each manager had a different approach. As a result, not all records and certifications were retained or readily accessible. Additionally, we noted personnel were manufacturing F-35 hardware with expired soldering and ESD certifications. Training ensures personnel proficiency in industry best practices, techniques, and methods. Without a rigorous training program, Honeywell cannot ensure the products delivered to BAE conform to expected workmanship standards.

Planning of Product Realization (7.1)

Configuration Management (7.1.3). Honeywell did not control software configuration changes made to the oxygen monitor software. Honeywell was making changes to the released oxygen monitor software using the developmental change control processes without the necessary reviews, classifications, and verifications required for released software. We found that changes were approved without identifying the actual change implemented, the severity of change, the impact on software requirements or specifications, and the level of retesting required for the change. Honeywell's software configuration control process poses a risk to system integration and performance because the changes were not evaluated by engineering and management.

Design and Development (7.3)

Design and Development Inputs (7.3.2). Honeywell conducted Preliminary Design Reviews (PDRs) and CDRs for the life support system, chemical biological filtered air system subassembly, and pilot interface connector without approved specifications. We noted that the Oxygen Monitor system software functions were not traceable to system requirements and have not been validated or verified. These functions included self-diagnostics, monitoring and control, and operating system interface standards. Without requirements definition, traceability, and verification; Honeywell cannot ensure all the F-35 requirements for production have been met.

Design and Development Outputs (7.3.3). Honeywell's software Version Description Document (VDD)[9] for the Oxygen Monitor system software does not adequately reflect the software configuration changes implemented and lacks other pertinent information regarding the released software build. We found that the VDD did not identify software configuration changes in the software baseline, did not state the new firmware configuration tested, and did not reference the required interface specifications. As a primary document used for configuration identification of the software, it lacked the principal elements to provide BAE sufficient insight into Honeywell's software configuration.

Design and Development Review (7.3.4). We documented that the chemical and biological filtered air supply test readiness review was not conducted prior to qualification testing in accordance with Honeywell's procedure. The purpose of a test readiness review is to provide management with the assurance that the requirements,

[9] Institute of Electrical and Electronics Engineers STD 610.12 defines VDD as, "The document that accompanies and identifies a given version of a system or component. Typical contents include an inventory of system or component parts, identification of changes incorporated into this version, and installation and operating information unique to the version described."

proposed method of verification, the test methods, and equipment to be tested are mature enough to commence testing. We also found that there were still 13 of 14 open action items from CDR. Open action items included updating the technical procurement specification to include acceptance testing and cleanliness level requirements, obtaining critical technical analysis for system safety, and determining how to protect against contamination and electromagnetic interference. Honeywell management elected to proceed into initial production without the chief engineer's approval in accordance with their design review procedure.

Purchasing (7.4)

We found circuit board assembly purchase orders that did not include the supplemental requirements for electronic and electrical components, such as defining lead and lead-free finishes, electronic solder requirements, and electronic markings. We also found that personnel were not verifying product technical data sheets as part of the product acceptance process. Specifically, Honeywell accepted a pressure switch gage using only a certificate of conformance even though an acceptance test data sheet was also required for acceptance. The lack of supplier performance requirement verification could result in quality escapes.

Production and Service Provision (7.5)

Control of Production and Service Provision (7.5.1). We found that personnel responsible for performing sampling of supplier components were not following the required sampling plan. For instance, the sampling plan required a minimum sample of 20 items; but only 1 item was sampled. In another instance, an operator removed a protective film prior to machining operations in contradiction of the drawing notes.

We found that the procedures for handling of environmentally sensitive material were insufficient. Honeywell personnel were not: recording and monitoring sealing compound pot life, recording high-strength adhesive film freezer out times, and recording and monitoring cure times for sealing compounds. Additionally, Honeywell personnel did not maintain production equipment and tooling in accordance with established procedures: soldering irons were not checked on a monthly basis, visual and leak test record sheets were not kept, equipment safety checks were not always performed, and production tooling was inadequately identified.

Preservation of Product (7.5.5). Honeywell was not ensuring personnel were following ESD and FOD procedures in the manufacturing and test areas. Oxygen monitor controllers were not stored in ESD-approved bags, static generators (e.g., a computer

keyboard, telephone, and computer monitor) were in close proximity to ESD mats, and a nonconductive production floor was used where ESD-sensitive items were processed. In the FOD-control area, we found that tools were not placed back on shadow boards and there was no accountability of piece parts (small nuts, bolts). Industry experience has shown that strict adherence to ESD and FOD procedures can prevent costly latent defects and hardware nonconformances.

Control of Monitoring and Measuring Equipment (7.6)

Honeywell's control of monitoring and measuring equipment was inadequate as evidenced by the following: uncontrolled environmental conditions in the calibration laboratory and processing areas; uncalibrated tools in production, test, inspection, and metrology areas; and no maintenance of software for measuring equipment. We found uncalibrated pin gages in the receiving inspection area, a digital voltmeter in the test lab, air pressure gauges in the OBOGS assembly area, and a supply pressure regulator in the calibration lab.

Control of Nonconforming Product (8.3)

Honeywell was not accurately completing quality notifications (QNs) used to document hardware nonconformances. We found that two nonconformances were dispositioned as repaired; however, a repair had not occurred. Honeywell also dispositioned another QN without documenting the root cause and corrective action. Accurate QNs are necessary to prevent recurrence of the nonconformance.

Analysis of Data (8.4)

Honeywell personnel implemented acceptance test procedural changes without the required BAE review and approval for the oxygen concentrator and OBOGS. Additionally, several ATP waivers/deviations were incorrectly categorized as minor rather than major. Requirement changes defined in either ATPs or waivers/deviations directly affect product performance and should be evaluated by BAE engineering.

BAE Systems Program Management at Honeywell

In performing quality assurance assessments of a supplier, we identified some findings against Honeywell's customer, BAE. We documented that BAE's SOW to Honeywell for LRIP 4 and LRIP 5 were not under configuration control and did not contain the appropriate document number. As a result, SOWs could not be traced to the appropriate contract, creating a risk that Honeywell may be manufacturing products to obsolete or incorrect program requirements.

Honeywell Assessment Summary

Our assessment indicated an immature product design and production processes. The design review process allowed the OBOGS program to enter CDR without firm specifications, exit CDR with 13 open actions, and allowed production to proceed with unapproved design documents. Additionally, verification of hardware and software performance requirements was not conducted to the approved acceptance test requirements.

Honeywell failed to communicate effectively to BAE the impact of changes and variances to the design. In several instances, Honeywell failed to obtain the necessary review and approval from BAE for changes to the Oxygen Concentrator acceptance test procedures and Oxygen Monitor software systems. Additionally, several variances were incorrectly categorized as minor when they should have been major, and should have been submitted to BAE for approval.

Process discipline issues were prevalent throughout the facility. We found numerous procedural and implementation issues in the areas of ESD, FOD, calibration, and control of LSLM. The issues highlight quality assurance and process discipline concerns that could introduce unscheduled rework and repair, leading to cost overruns and schedule slips.

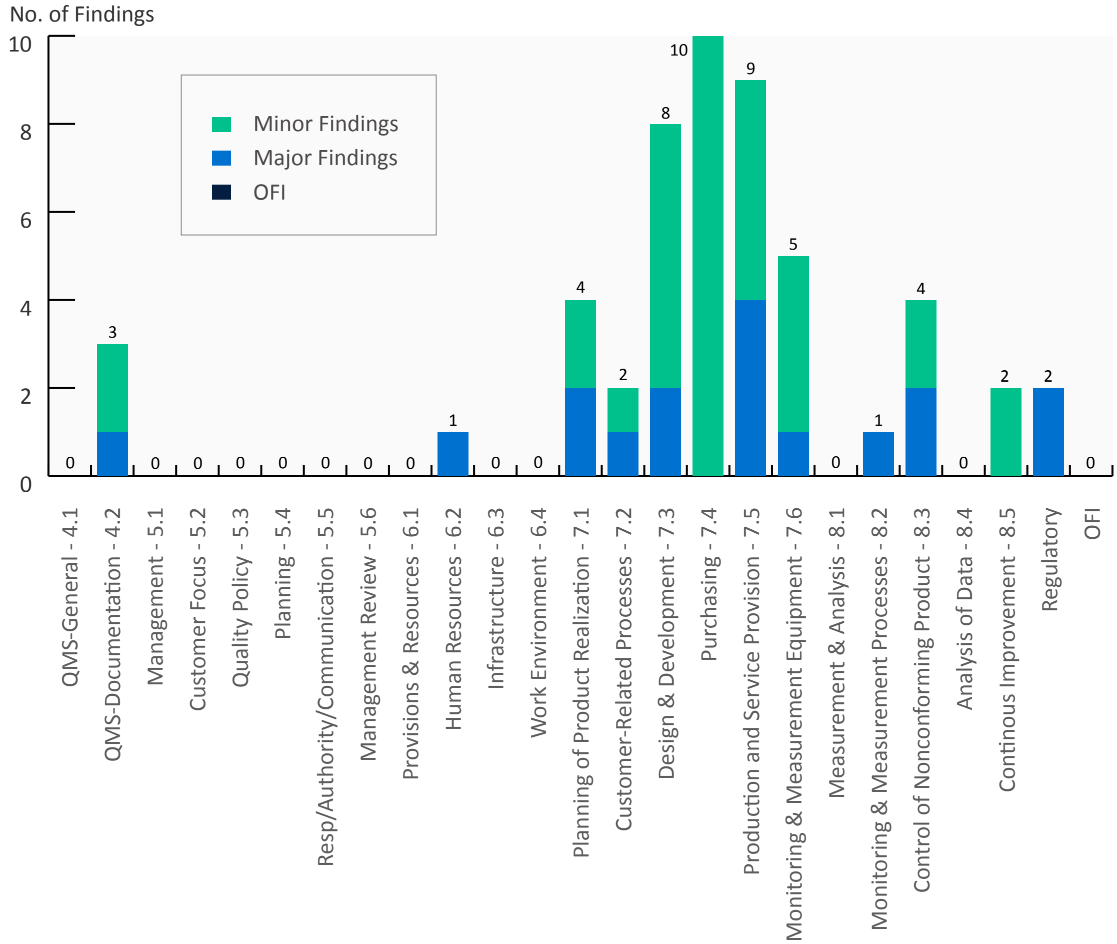
United Technologies Corporation, Aerospace Systems

(Fort Worth, Texas, and Independence, Ohio)

UTAS is a Lockheed Martin subcontractor that manufactures the landing gear for the F-35 Lighting Aircraft. The landing gear assembly line recently moved from Independence, Ohio, to Fort Worth, Texas. The move began in January 2012, with the first landing gear assembly delivered from the new facility in October 2012. In July 2012, UTAS purchased the Goodrich division that was the original manufacturer of the F-35 landing gear. At the time of our assessment, all the engineering offices were still in Ohio; only the assembly line and supporting activities had moved to Texas. UTAS provides landing gear for all three F-35 variants: CTOL, CV, and STOVL.

The assessment of UTAS resulted in 51 findings that identified deficiencies in UTAS' implementation of the AS9100 Quality Management System. The findings identified issues with DCMA delegations and their implementation along with Lockheed Martin's insufficient supply chain management of critical suppliers. Figure 13 provides UTAS findings by AS9100 clause with the following sections summarizing significant issues documented during the assessment.

Figure 13. UTAS Findings



Documentation Requirements (4.2)

We found that the quality assurance inspection control plans used in the inspection of hardware were not under configuration control. Four quality assurance inspection control plans found on the production floor had been updated by engineering but not signed or released in accordance with UTAS procedures. Thirty-seven other documents, such as quality assurance documents, landing gear documents, and engineering quality assurance procedures; had not been reviewed for adequacy or released in accordance with their procedures.

Human Resources (6.2)

Competence, Training, and Awareness (6.2.2). We found that UTAS used multiple training systems that were not maintained, resulting in incomplete training requirements, incomplete records, and the employees' training effectiveness not being assessed. We found that training records were incomplete, lacking training requirements and due dates. The document system left uncertainty that employees had all the necessary training.

Planning of Product Realization (7.1)

We documented some tools and equipment that had not been proof loaded. Specifically, one crane with various riggings was not proof loaded or certified for the F-35 landing gear assemblies. This did not meet safety and occupational health requirements.

Configuration Management (7.1.3). We found that UTAS did not certify or update its configuration management policy to reflect the Lockheed Martin requirements. Change control, classification of changes, and notification to the customer of pending changes were not accomplished. For instance, Lockheed Martin's configuration management requirements stated that a change to solder composition should be a major change; however, this requirement was not included in the UTAS configuration management plan.

Customer-Related Processes (7.2)

Customer Communication (7.2.3). UTAS Fort Worth did not submit minor variances to DCMA for review and approval. Lockheed Martin requires that both major and minor variances be submitted to DCMA for evaluation to ensure the classification is correct and is appropriately dispositioned. We found that minor variances had not been submitted; therefore, the classification of nonconformances and dispositions may not be technically correct.

Design and Development (7.3)

We found that UTAS had not completed the corrosion protection plan for the F-35 CV landing gear in accordance with the SOW. The corrosion protection plan is necessary to define adequate design and maintenance requirements for the landing gear to ensure performance in a high humidity and salt spray environment. We also identified that UTAS had not received Lockheed Martin's approval for 10 item development specifications and an interface control document (ICD) prior to the start of LRIP. Items such as several actuators and wire harnesses, a swivel, switch, pressure transducer, fluid sensor, and the electrical interface drawing had not been approved. The unapproved item development specifications dated back to 2004, and the unapproved electrical ICD dated back to 2009.

Additionally, we identified that the UTAS testing program did not ensure all technical performance requirements were verified. For example, not all Brake/Skid Control System performance-based specification requirements were part of the qualification test program. In addition, the maintainability and health management performance-based requirements had not been demonstrated as required by the performance-based specification.

Purchasing (7.4)

UTAS was not flowing down all applicable F-35 Program unique quality assurance requirements to its suppliers. UTAS purchase orders did not include Lockheed Martin supplier quality assurance requirements, such as quality management system requirements, calibration requirements, and Government oversight requirements. We also noted numerous deficiencies with UTAS' review and approval of manufacturing plans. UTAS did not maintain required monthly supplier quality assurance metrics; therefore, supply chain risks were not identified.

We noted inconsistencies in the information contained in the UTAS SAP[10] system versus the information residing in the supplier quality assurance database. The process for supplier rating, certification, and decertification did not follow UTAS procedures for procuring parts from qualified and authorized suppliers. Insufficient supplier management practices may produce defective parts that go undetected.

Product and Service Provision (7.5)

Control of Production (7.5.1). We documented that the UTAS master-tooling list had not been updated and was inaccurate. The calibration vendor for UTAS identified 199 UTAS tools in its calibration service purchase order; however, UTAS' master-tooling list identified only 128. In addition, many tools on the UTAS production floor including the acceptance testing fixtures and numerous small tools and gauges showed no evidence of inspection by the quality assurance organization prior to use in production.

UTAS was not following procedures for FAIs. Specifically, UTAS did not ensure that F-35 landing gear system FAI data packages were consistently reviewed and approved and contained the necessary supporting data. FAI is a process used to verify and document all essential characteristics on one of the first production components and provides confidence that production processes, documentation, and tooling are sufficient to begin production. Several FAI packages were categorized as "FAI Not Complete," with no corresponding data to explain why they had not been completed.

Preservation of Product (7.5.5). UTAS procedures for FOD, ESD, and LSLM did not ensure product protection; personnel were also not always implementing them correctly. In one finding, FOD-controls were not adequate to prevent FOD from being introduced into the product. Examples of FOD objects noted in the F-35 assembly area include soda bottles on tool/storage racks, a loose protective cap, residual tape, a small plastic bag,

[10] SAP is a German corporation that develops business enterprise software.

a part identification label, a cigar, and sunflower seeds. We noted that UTAS did not have an ESD workstation or instructions for handling ESD-sensitive components in the production area. The UTAS F-35 product line contains ESD-sensitive components such as the brake control unit and the pressure transducer. We also identified several examples of inappropriately labeled LSLMs with missing expiration dates. Examples included O-ring lubricant, sealing compound, red torque lacquer, and leak detection solution.

Control of Monitoring and Measurement Equipment (7.6)

We documented several findings related to the control of monitoring and measurement equipment. We found a brake positioning transducer that was calibrated, but the inspection report failed to provide the actual calibration values; therefore, it could not be determined if the tool was capable of making reliable measurements. On a transducer jig, the flatness/parallelism requirement was not verified as part of the inspection procedure and was not recorded in the report. Another finding documented that the tool identification information for torque operations was not recorded on multiple shop travelers as required for traceability. Several additional findings documented deficiencies with the inventory list, identification methods, and recordkeeping. Although there were processes to control monitoring and measurement equipment, the findings indicate that improvements are necessary to produce a reliable product.

Monitoring and Measurement (8.2)

Internal Audit (8.2.2). The assessment documented one major finding related to internal audits. No product audits have been performed on F-35 landing gear assemblies at the UTAS Fort Worth facility to ensure hardware meets end-item requirements. Failure to complete product audits as planned increases risk of deficient processes.

Control of Nonconforming Product (8.3)

We found that nonconforming hardware was dispositioned by unauthorized personnel instead of the required engineering representative, and did not go through the material review process. In addition, one of the nonconforming items we evaluated could not be located.

UTAS was not tracking corrective actions to closure for product nonconformances and variances; therefore, UTAS was unaware of the status of these corrective actions. In addition, we found that UTAS was not performing root cause and corrective action for scrapped F-35 parts and was not submitting variances and scrap dispositions to DCMA as required. Insufficient corrective action and lack of Government oversight increases the risk of additional nonconforming items affecting product reliability and program cost.

Lockheed Martin Program Management at UTAS

We reviewed the effectiveness of Lockheed Martin program management as part of our assessment at UTAS. Lockheed Martin flowed down the F-35 Brake/Skid Control System performance-based specification with incomplete and conflicting specification requirements. We also found at the time of our assessment that Lockheed Martin had not funded root cause and corrective action analysis for failed UTAS hardware. Failed parts and detailed information of the field failure was not always provided back to UTAS for analysis; therefore, UTAS was unable to determine root cause.

We found that there was no evidence that Lockheed Martin had ever provided "concurrence in classification" for minor engineering changes submitted by UTAS. UTAS personnel indicated that after 30 days, they assumed that Lockheed Martin agreed with the classification. Lack of Lockheed Martin agreement with UTAS-initiated minor changes can result in changes being incorporated and implemented without the proper review and approval.

DCMA Oversight

We found that DCMA Cleveland did not provide the required Government oversight of UTAS waivers, deviations, and nonconformances as required by the LOD. Additionally, DMCA Cleveland was not delegating nonconforming material review responsibilities to the appropriate DCMA offices located at UTAS suppliers.

UTAS Assessment Summary

We found a lack of disciplined process controls for FOD, ESD, and LSLM. This could result in nonconforming flight hardware or latent defects.

Several key design and development tasks were not completed. Although the program has transitioned to LRIP, UTAS had not received Lockheed Martin's approval for 10 development specifications and ICDs. UTAS also had not verified technical performance requirements testing prior to the start of LRIP.

UTAS did not conduct internal audits at the Fort Worth facility, and was not tracking corrective actions to closure for product nonconformances and variances. The lack of an internal auditing program and disciplined corrective action process could result in quality assurance issues and additional cost growth to the program.

Overall Findings and Recommendations

The F-35 Program did not sufficiently implement or flow down technical and quality management system requirements to prevent the fielding of nonconforming hardware and software. This could adversely affect aircraft performance, reliability, maintainability, and ultimately program cost. Lockheed Martin and its subcontractors did not follow disciplined AS9100 Quality Management System practices, as evidenced by 363 findings, which contained 719 issues.

A. Insufficient Rigor in Design, Manufacturing, and Quality Assurance Processes

The F-35 JPO, Lockheed Martin, and its subcontractors were not ensuring that the necessary quality assurance process controls and disciplines were in place to produce a consistent and reliable product. This lack of process discipline and attention to detail creates an elevated risk of delivering nonconforming aircraft to the warfighter.

The root cause of nearly half of the findings was the lack of adherence to established processes and procedures or insufficient detail in documentation. The major process discipline issues were in the following areas.

- **Planning for Product Realization** – Production planning lacked the appropriate level of detail, design changes were uncontrolled or unapproved, and system-level plans were not maintained. As a result, documentation did not always match the processes and equipment required to perform the manufacturing operation.
- **Design and Development** – Contractor personnel were using insufficient or unapproved test plans and procedures. Systems engineering technical review entrance and/or exit criteria were not met. The criteria ensure the program is ready to proceed to the next production milestone or test event.
- **Software Development** – In some cases, software design and development activities lacked definition and rigorous adherence to documented procedures and processes, resulting in software development requirements not implemented, traceable, and verified.

- **Manufacturing Operations** – Contractor personnel were not following documented manufacturing and assembly process instructions necessary to ensure conformance to end-item requirements, product protection, and material control.
- **Production Tooling** – Uncontrolled and unproven tooling was in use on the production floor, resulting in product nonconformances.
- **Calibration of Measurement Systems** – Multiple sites had inadequate calibration management systems. Contractors were not performing out-of-tolerance condition analyses, using sufficient calibration procedures, and removing expired calibrated equipment from use. Accurate test and measurement equipment is necessary to provide accurate measurements that determine product acceptability.
- **Engineering Change Management** – Lockheed Martin was not reviewing and approving all subcontractor submittals for variances and engineering change requests for which Lockheed Martin is the sole design authority. Additionally, Lockheed Martin was not providing concurrence for engineering change classifications for subcontractor engineering changes.

Recommendation A—Management Comments and Our Response

We recommend that the Joint Program Office:

1. **Ensure compliance with AS9100 throughout the F-35 supply chain.**

Joint Program Office Comments

JPO agreed and stated:

> AS9100 (Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations) is an F-35 contractual requirement. The prime contractor (Lockheed Martin (LM)) is AS9100 certified and has flowed down this quality requirement to its supply chain. AS9100 certification is granted by a third party accredited entity. Periodic reviews are held by that third party entity to maintain certification. Annual self audits are conducted by both the prime contractor and its suppliers to monitor compliance within their respective facilities. The Government has had

> limited insight to results of these self audits, however, DCMA performs onsite process reviews as part of its oversight activity. DCMA at Lockheed Martin Fort Worth reorganized in February 2013 to provide more focus and inspection emphasis to ensure AS9100 compliance and a quality product. Additionally, JPO reviews AS9100 certification status of critical suppliers during their annual Production Readiness Reviews (PRR). These reviews serve as a LRIP risk management tool conducted with the prime contractor and selected major critical suppliers, covering Technical, Production and Sustainment requirements. Suppliers must demonstrate consistent adherence of product compliant to contractual (AS9100) and applicable statutory and regulatory requirements. Findings of this IG audit have caused both contractor and Government entities to adjust the frequency and scope of independent audits to ensure greater insight to AS9100 compliance.

Our Response

The comments from JPO are responsive, and the actions taken appear to meet the intent of the recommendation.

2. **Ensure that Lockheed Martin approves all design and material review board changes and variances with Government concurrence.**

Joint Program Office Comments

JPO agreed and stated:

> Current F-35 Program plans (such as the Configuration Management Plan) require that all major design changes and variances for production aircraft receive Government concurrence. The Government maintains limited insight of the contractor's Material Review Board (MRB) process. Subsequently, the Government has reprioritized and refined its engagement in that process to ensure improved effectiveness. For nonconformances that require MRB disposition, JPO delegates the approval of Class II (minor) changes to DCMA and reviews all Class I changes that affect form, fit, or

> function. A Class I change request is dispositioned through the JPO Change Review Board (JCRB), which performs a technical and business assessment and provides a written recommendation to the Joint Configuration Control Board (JCCB). With the input of major stakeholders, the JCCB adjudicates the recommended change and provides that decision to Contracts, who notifies the Prime Contractor to proceed in incorporating the change.
>
> Any subcontractor submittal for variances and engineering change requests, for which Lockheed Martin is the sole design authority, must be go through Lockheed Martin's change control boards for review and approval. Furthermore, Lockheed Martin must provide concurrence for engineering changes relating to subcontractor owned designs. Various configuration management checks and balances (such as Physical and Functional Configuration Audits) are in place to ensure control.

Our Response

The comments from JPO are responsive. The actions taken appear to meet the intent of the recommendation; however, the DoD OIG suggests that the JPO and Lockheed Martin maintain cognizance of class II changes.

3. **Perform process proofing of all critical processes to include first article inspections.**

Joint Program Office Comments

JPO partially agreed and stated:

> The Government does not have the resources to perform process proofing of all critical processes. Responsibility and accountability rests on the prime contractor, with oversight from the Government. Process proofing and First Article Inspections are Program Plan and contractual requirements. The Government performs audits of process compliance to ensure the contractor is controlling critical operations. The

Government closely monitors scrap, rework, and repair to ensure the contractor is conducting proper root cause analyses to implement appropriate corrective actions. The Government also monitors the quality of delivered product to ensure control of escaped defects.

JPO requires the contractor to perform First Article Inspections (FAI) and process proofing as part of their implementation of AS9100 and the F-35 Program Quality Management Plan. Over 27,500 original baseline FAIs have been completed and approximately 400 more delta FAIs will be performed for parts due to concurrency, producibility, process changes, etc. In addition, the prime contractor has implemented variation management, which is an advanced quality system technique that focuses on defect prevention and continuous improvement through the identification of key product and process characteristics. This allows greater control of the manufacturing process.

Our Response

Although we understand the concern for Government resources, we still recommend that JPO ensure process proofing of all critical processes. A widely accepted industry handbook on quality, *Juran's Quality Handbook*, defines critical properties as: "Critical properties are those properties for which the made-product total variability is so wide as to cause persistent difficulty in meeting current or near-term anticipated customer needs." The Government must ensure that the contractor performs some level of process proofing to prevent, as *Juran's Quality Handbook* states, "variability in critical product characteristics, which is the enemy of quality of conformance."

As evidenced by the findings, process proofing had not been accomplished to the level to ensure product repeatability. It is the DoD OIG's position that without process proofing of all critical processes, quality assurance may not be achieved. Therefore, we request further comments from the JPO in response to the final report.

4. **Modify its contracts to include a quality escape clause to ensure the Government does not pay for nonconforming product.**

Joint Program Office Comments

JPO agreed and stated:

> JPO concurs that greater incentives should be taken to preclude the cost of poor quality. Major non-conformances that do not meet engineering specification are identified and adjudicated for acceptance or rejection with considerations/withholds placed on a variance. Minor non-conformances are reworked, repaired, or used as is. The program has transitioned to fixed price type contacts with a 0/100 share ratio and clauses will prescribe to applicable FAR [Federal Acquisition Regulation] requirements. Along with considerations/withholds on non-conformances, this contract structure will facilitate greater incentive by the contractor to provide quality assurance in order to maintain cost and schedule obligations without over running their negotiated budget. The contractor will absorb a level of cost for poor quality. In addition, the JPO continues to establish quality performance targets with commitments from JPO and LM senior leadership. These targets are based upon continuous learning in fabrication and assembly operations, corrective action implementation, in addition to product and process improvements as a result of affordability and concurrency changes.

Our Response

The comments from JPO are responsive, and the actions taken appear to meet the intent of the recommendation.

5. Assess the impacts and risks to all delivered aircraft for all findings.

Joint Program Office Comments

JPO agreed and stated:

> The impacts and risks of all findings were assessed as part of the Corrective Action Request (CAR)/Corrective Action Plan (CAP) process. When a CAR was written, the

> F-35 fleet was assessed for impact. Concurrence on each CAP considered effectivity, safety, and contract elements. This determined priority and timing required to implement the corrective action into the affected aircraft as appropriate.

Our Response

The comments from JPO are responsive, and the actions taken appear to meet the intent of the recommendation.

B. Critical Safety Item Program Not Implemented

> The F-35 JPO did not include CSI requirements on the Lockheed Martin prime contract as required by Public Law and DoD policy. Aircraft CSIs were not identified and critical parts were not manufactured with CSI controls and verifications. Delivered aircraft may pose an increased safety of flight risk due to the lack of critical process control.

JPO has not flowed down a contractual requirement to Lockheed Martin (and subsequently, its subtier suppliers) to implement a CSI management program in accordance with Public Law and DoD policy. A CSI is a part, assembly, or support equipment whose failure could cause loss of life, permanent disability or major injury, loss of a system, or significant equipment damage. Special attention should be paid to CSIs to prevent the potential catastrophic or critical consequences of failure. CSIs require special handling, engineering, manufacturing, and inspection documentation to control and ensure safety of flight.

Public Law 108-136, Section 802, "Quality control in procurement of aviation CSIs and related services," requires DoD to prescribe a quality control policy for the procurement of aviation CSIs. Joint Service CSI Instruction, "Management of Aviation Critical Safety Items," implements the DoD CSI program and establishes the policies, procedures, and responsibilities to manage CSI. The Joint Aeronautical Commanders Group, "JACG Aviation Critical Safety Item Handbook," implements the policies in the Joint Service CSI Instruction and describes the technical and quality assurance requirements for a Prime Manufacturer CSI program. Without a CSI program, there is an increased safety risk to the aircraft and warfighter.

Recommendation B—Management Comments and Our Response

We recommend that the Joint Program Office:

1. **Implement an aviation critical safety item program that meets the requirements of Public Law and DoD policy, which would include flow down of requirements for a critical safety item program to Lockheed Martin and its subcontractors.**

Joint Program Office Comments

JPO agreed and stated:

> JPO is working with the prime contractor in developing a Request for Proposal (RFP) for a two-phased CSI Non Recurring Engineering (NRE) approach. This will require the development of comprehensive CSI requirements which will be added to the SDD contract's Statement of Work. These requirements will address the identification of critical characteristics that enable compliance at the prime contractor and throughout its supply base. Once the SDD NRE efforts are completed, the full scope of the F-35 CSI program will be included in future production and sustainment contracts. Commencement of certain initial recurring tasks will be implemented using the LRIP 6 contract. In the interim, the contractors' integrity and quality programs are providing assurance for continued aviation safety.

Our Response

The comments from JPO are responsive, and the actions appear to meet the intent of the recommendation.

2. **Assess the impacts and risks to all delivered aircraft for critical safety item deficiencies.**

Joint Program Office Comments

JPO agreed and stated:

> Deficiencies and impacts to critical parts are identified and assessed during quality assurance practices and testing operations as part of the SDD design and product verification processes. If safety issues and limitations are discovered, changes are initiated and incorporated as warranted to the test and production aircraft. Initial and continued airworthiness is a major focus of the F-35 Class Desk, Airworthiness Team, Integrated Test Team, and Integrated Product Teams. The SDD test aircraft have more than 5,000 flight hours. The combined F-35 fleet has accumulated more than 7,000 flight hours. This is not to say that there are no significant issues or discoveries. Rather, there is an upfront understanding whether any new discovery poses an increased safety risk. If necessary, proper actions are taken, such as suspending flight operations, directing inspections, adding flight limitations or restrictions, and directing hardware or software modifications to mitigate the safety risks.

Our Response

The comments from JPO do not meet the intent of the recommendation. Per our findings the JPO did not create a CSI program in accordance with Public Law 108-136, Section 802. The DoD OIG desires the identification and confirmation from the Engineering Support Activity that all safety risks for aircraft manufactured and delivered to the Government using the methodology identified in the CSI handbook is complete. Therefore, we request further comments from the JPO in response to the final report.

C. Requirements Not Flowed Down

> JPO and Lockheed Martin did not ensure that all essential quality assurance and technical requirements were flowed down to the supply chain. This resulted in suppliers providing critical F-35 products that may not meet intended performance and reliability requirements.

We noted a significant number of findings in this area. These include the following.

- **First Article Inspection** – Lockheed Martin flowed down conflicting requirements for FAIs to its suppliers. The lack of definitive FAI requirements was affecting the suppliers' ability to qualify its processes and ensure delivery of compliant product.

- **Configuration Control** – Lack of flow down and communication between Lockheed Martin and suppliers was causing unclear configuration management and status accounting requirements. Configuration issues at suppliers were resulting in products with unknown configurations.

- **Design and Development Requirements** – Lockheed Martin did not flow down all the necessary design and development requirements and ensure requirements were verified and traceable. This impacted the suppliers' ability to develop products that meet expected performance requirements.

- **Diminishing Manufacturing Supply and Materiel Shortages** – JPO had not funded Lockheed Martin to implement a DMSMS program. As a result, the program was not proactively forecasting for part obsolescence.

Recommendation C—Management Comments and Our Response

We recommend that the Joint Program Office perform technical and quality assurance requirement flow down and verification throughout the F-35 supply chain.

Joint Program Office Comments

JPO partially agreed and stated::

> The Government does not have the responsibility or resources to perform requirement flow down verification throughout the prime contractor's entire supply chain. The prime contractor is responsible and accountable, with oversight from the Government. The Government performs spot checks and conducts surveillance to ensure the contractor is flowing down requirements to its subcontractors. The Government

> monitors this closely through participation in Design Reviews, Production Readiness Reviews, Structural Equivalency Reviews, Program Management Reviews, production floor inspections, configuration audits, etc. On site surveillance is primarily performed by DCMA to ensure the contractor and its subcontractors are complying with contractual requirements.

Our Response

The DoD OIG does not agree that the Government does not have the responsibility to ensure that the prime contractor and the supply chain meet requirements. In accordance with DoDD 5000.01, section 3.5, the Program Manager has the responsibility for and authority to accomplish program objectives for development, production, and sustainment to meet the user's operational needs. The intent of our recommendation is for JPO to ensure that technical and quality assurance requirement flow down occurs by establishing the appropriate contractual requirements; such as having the prime contractor create a database showing each supplier and all applicable performance and quality assurance requirements. Contractual deliverables such as database access and various monthly metrics would provide the Government additional confidence that this has occurred. The lack of a requirement flow down process to date has hampered the program's understanding of supplier conformance to performance and quality contractual requirements. Therefore, we request further comments from JPO in response to the final report.

D. Ineffective Quality Assurance Organization

> JPO's quality assurance organization did not have the appropriate resources and authority to effectively manage DoD's largest acquisition program. The lack of a strong and effective quality assurance organization contributed to the program's cost, schedule, and performance issues.

DoDD 5000.01, "The Defense Acquisition System," designates authority and responsibility to the program manager within JPO to accomplish program objectives for development, production, and sustainment to ensure that reliable systems are delivered to the warfighter. DoDD 5000.01 goes on to state that the program manager, "shall be the single

point of accountability for accomplishing program objectives for total life-cycle systems management." As evidenced by our assessment that identified 363 findings, JPO appeared to rely on Lockheed Martin and DCMA to identify, report, and address quality assurance issues. This indicates a lack of quality assurance and technical expertise within JPO to recognize F-35 supply chain issues.

Furthermore, the Lockheed Martin Aeronautics quality assurance leadership team reports to the Lockheed Martin Aeronautics operations leadership team and does not have the organizational independence or inherent authority to enforce quality assurance internally and throughout the F-35 supply chain. It should be noted that Lockheed Martin Space Division has an independent quality assurance organization that does not report to operations.

Recommendation D—Management Comments and Our Response

We recommend that the Joint Program Office establish an independent quality assurance organization, which has the authority and resources to enforce the AS9100 standard and F-35 product quality.

Joint Program Office Comments

JPO disagreed with the recommendation. JPO stated:

> JPO acknowledges opportunities to improve management of Quality performance and the benefits of realignment within the F-35 Program organizational structure to better support transition from Low Rate Initial Production to Full Rate Production. These efforts have commenced to include an increase in resources and realignment of the Quality Team to report to program leadership. The JPO non-concurs with establishing an independent quality assurance organization. DCMA performs the role of the independent quality assurance organization for the F-35 and other DoD programs. DCMA conducts process surveillance against the AS9100 standard and enforces F-35 product quality requirements. Additionally, the JPO Quality Team is staffed from two independent organizations; Air Force Life Cycle Management

Center (AFLCMC) and Naval Air Systems Command (NAVAIR). While serving on the JPO Quality Team, these individuals retain their responsibility to invoke their independent AFLMC and NAVAIR leadership in the event the JPO does not properly address quality concerns.

Our Response

We disagree with JPO's approach because DCMA, AFLCMC, and NAVAIR are not accountable for program quality assurance goals. In accordance with DoDD 5000.01, section 3.5, the Program Manager has the responsibility for and authority to accomplish program objectives for development, production, and sustainment to meet the user's operational needs. Quality assurance is inherently a Government program office's responsibility. As evidenced by our findings, JPO did not enforce F-35 product quality requirements. DCMA uses a "riskbased surveillance approach" to apply resources across the DoD. Based on the findings from our assessment, DCMA did not apply the appropriate resource throughout the supply chain. JPO must ensure that Government resources are integrated into the program, efficiently applied, and understand the system criticality of each aircraft component. It should also ensure that design, test, and manufacturing issues are addressed with long-term, permanent solutions. The DoD OIG seeks an effective quality assurance organization that meets these expectations. Therefore, we request further comments from JPO in response to the final report.

E. Ineffective DCMA Oversight

DCMA was not performing quality assurance oversight commensurate with product criticality. Insufficient written direction from JPO coupled with inadequate execution from DCMA resulted in ineffective Government oversight of the F-35 Program.

In accordance with the F-35 Program memorandum of agreement, DCMA has been delegated the responsibly of final acceptance of each production article. The memorandum states "DCMA will issue LODs to support Contract Management Offices for key JSF subcontractors as defined by DCMA and based on the analysis of subcontractor performance data and risk." In addition, DCMA will analyze contractor-earned value data and provide an assessment of program risk based on cost, schedule, and technical

performance. DCMA will also maintain the Joint Surveillance Plan (between DCMA and Lockheed Martin). The plan provides the details for accomplishing system surveillance and maintenance.

Although there was a memorandum of agreement between JPO and DCMA, it was inadequate for the complexity of the F-35 Program. The memorandum of agreement did not provide any specifics to ensure adequate oversight of the F-35 supply chain. DCMA Fort Worth did not issue letters of delegation to cognizant DCMA offices at key F-35 suppliers based on the analysis of supplier performance data and risk. DCMA did not consistently:

- develop or implement risk-based surveillance plans in accordance with DCMA policies,
- participate in material review board activities,
- adequately conduct oversight activities, and
- identify and report oversight activities performed at lower tier suppliers.

Recommendation E—Management Comments and Our Response

1. We recommend that the Joint Program Office:

a. Revise the Defense Contract Management Agency memorandum of agreement to provide explicit surveillance criteria for mission-critical hardware and software, to include, but not limited to, material review, mandatory government inspection, process audit, product acceptance.

Joint Program Office Comments

JPO agreed and stated:

> The Memorandum of Agreement (MOA), annex A-P, dated February 2011, between the JPO and DCMA is being updated to reflect Program objectives requiring DCMA support in the following areas: Management of contractor Quality Process implementation, control, maturity, and verification; Material Review/Change Board Process authority and related task requirements, Foreign Object Damage (FOD) management, Government Flight Representative surveillance, Safety of

> Flight inspection requirements, contractual Corrective Action Request notification, Air system acceptance (DD250), Supply Chain Management, etc. However specific surveillance activities and priorities are articulated via other tools, such as Quality Assurance Letters of Inspection (QALI's).
>
> It is important to note that the MOA update, though crucial in shaping organizational roles and responsibilities that address the findings in this report, is only part of the corrective action process being implemented. Execution of DCMA policies, enhanced communication between the JPO and DCMA, and enhanced inter-DCMA communications with supplier DCMA organizations all play a role in improving surveillance. In addition to the MOA, DCMA utilizes risk based surveillance plans to support F-35 contracts. As part of the functional surveillance planning process, DCMA determines what types of surveillance techniques will be applied to ensure a supplier has adequate quality processes in place and meet all contractua lrequirements. Risks are identified through historical knowledge of the suppliers systems and processes, results of surveillance execution, analysis of DCMA internal data, supplier data and customer data.

Our Response

The comments from JPO are responsive and the actions met the intent of the recommendation.

b. Ensure that Defense Contract Management Agency is performing quality assurance oversight commensurate with product criticality.

Joint Program Office Comments

JPO agreed and stated:

> DCMA has been, and continues to be, responsive to product criticality while performing its contact administration quality assurance functions. This includes optimizing quality assurance oversight of contractors' critical processes, operations, and product. Product criticality is governed by

> Federal Acquisition Regulation derived surveillance strategies. FAR/DFAR regulatory requirements as manifest in F-35 contracts are also guided by DCMA policies. DCMA policies define risk considerations and thresholds in developing surveillance plans. Quality specialists determine what types of surveillance techniques will be applied to ensure a supplier has adequate quality processes in place. Surveillance activities and data analysis allow DCMA to re-evaluate risk levels and where appropriate adjust surveillance plans.
>
> As non-conformance is identified, JPO may request special surveillance be performed in other areas due to severity or whether they are systematic in nature. This is captured in other documents such as QALI's. The DCMA monthly report also is a means of communicating quality assurance oversight as it pertains to production status. Continuous communication between JPO and DCMA to discuss and resolve quality issues is critical to meeting Program objectives. Performing quality assurance in accordance with product criticality is central to how DCMA conducts contract surveillance.

Our Response

The comments from JPO do not meet the recommendation intent. As evidenced by the findings, DCMA is not providing sufficient supply chain oversight commensurate with product criticality. The term "surveillance," as defined in Federal Acquisition Regulation (FAR) 42.11, is broad and does not specifically equate to government verification or inspection of manufacturing processes or products. As an example, the DCMA surveillance for a supplier could be nothing more than an itinerant DCMA person visiting a particular supplier every six months with the visit entailing a brief walk through of the facility. Therefore, it is our position that JPO's quality assurance organization should make the final decision on supplier risk, and the type and amount of DCMA surveillance. We request further comments from the JPO in response to the final report.

2. We recommend that the Defense Contract Management Agency:

a. Provide a comprehensive quality assurance oversight plan for Joint Program Office approval to be included in the memorandum of agreement.

Defense Contract Management Agency Comments

DCMA partially agreed. DCMA stated:

> DCMA will ensure the MOA, as currently being updated, complements DCMA risk based surveillance planning. The DMCA surveillance planning process is risk based and developed through historical knowledge of the suppliers systems and processes, results of surveillance execution, analysis of DCMA internal data, supplier data and customer data.
>
> DCMA is also implementing a dedicated Supply Chain Management team at LMFW [Lockheed Martin, Fort Worth] to address the significant supply chain oversight challenge of the F-35 program. The focus of the team will be to evaluate LMFWs supply chain processes and system as well as a more focused emphasis on risk suppliers throughout the Supply Chain.

Our Response

The comments from DCMA do not meet the recommendation intent. As stipulated in our E.1.b response, it is important for JPO's quality assurance organization to make the final decision on supplier risk and the type and amount of DCMA oversight. A comprehensive quality assurance oversight plan would specifically identify DCMA oversight for critical assemblies: inspection, verification, and process proofing. Therefore, we request further comments from the DCMA in response to the final report.

b. Audit the execution of the quality assurance oversight plan throughout the F-35 supply chain.

Defense Contract Management Agency Comments

DCMA agreed and stated:

> DCMA will comply with its quality assurance oversight plan. Regular audits of supplier and prime DCMA organizations are crucial to maximizing the effectiveness of risk based surveillance. Within DCMA, Management Review Teams (MRT) provide comprehensive functional reviews on our quality program. These risk-based audit efforts, are conducted by independent quality experts and occur throughout the entire DCMA organization ensuring coverage of the F-35 supply chain. Continued communication of audit results with our customers and enhanced communication between DCMA supplier CMOs will also supplement a robust audit process.

Our Response

The DCMA comments do not meet the recommendation intent. DCMA states they will comply with its existing quality assurance oversight plan, which does not appear to be the comprehensive F-35 quality assurance oversight plan sought in our E.2.a recommendation. In addition, the DCMA audit and MRT process cited is not new and as identified by our assessment was insufficient. Therefore, we request further comments from the DCMA in response to the final report.

Appendix A

Scope and Methodology

We conducted this assessment from February 2012, through July 2013, in accordance with the Council of the Inspectors General on Integrity and Efficiency, "Quality Standards for Inspection and Evaluation." Those standards require that we plan and perform the assessment to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our assessment objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our assessment objectives.

To review the quality management system, our assessments focused on the following:

- Applicable Statutory/regulatory requirements
- Contractual quality management system (AS9100)
- Contractual quantity clauses
- Internal quality assurance processes and procedures
- Software quality assurance process
- Aviation CSI

Use of Technical Assistance

We used assistance from quality assurance engineers and quality assurance specialists with a background in defense and aerospace systems. We established teams of subject matter experts who assessed to the AS9100C Quality Management System standard. The subject matter expert teams consisted of 14 to 18 quality assurance engineers, trained and certified in AS9100, who had an average of 15 years of quality assurance, audit experience. Additionally, our teams included subject matter experts in military aviation CSI.

Appendix B

Prior Coverage

During the last 5 years, the Government Accountability Office (GAO) and the Department of Defense Inspector General (DoD IG) issued 26 reports discussing F-35 Joint Strike Fighter. Unrestricted GAO reports can be accessed over the Internet at http://www.gao.gov. Unrestricted DoD IG reports can be accessed at http://www.dodig.mil/pubs/index.cfm.

GAO

Report No. GAO-13-690T, "F-35 Joint Strike Fighter: Restructuring Has Improved the Program, but Affordability Challenges and Other Risks Remain," June 19, 2013

Report No. GAO-13-294SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 28, 2013

Report No. GAO-13-309, "F-35 Joint Strike Fighter: Current Outlook Is Improved, but Long-Term Affordability Is a Major Concern," March 11, 2013

Report No. GAO-12-437, "Joint Strike Fighter: DOD Actions Needed to Further Enhance Restructuring and Address Affordability Risks," June 14, 2012

Report No. GAO-12-400SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 29, 2012

Report No. GAO-12-525T, "Joint Strike Fighter: Restructuring Added Resources and Reduced Risk, but Concurrency Is Still a Major Concern," March 20, 2012

Report No. GAO-11-903R, "Joint Strike Fighter: Implications of Program Restructuring and Other Recent Developments on Key Aspects of DOD's Prior Alternate Engine Analyses," September 14, 2011

Report No. GAO-11-677T, "Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Is Still Lagging," May 19, 2011

Report No. GAO-11-325, "Joint Strike Fighter: Restructuring Places Program on Firmer Footing, but Progress Still Lags," April 7, 2011

Report No. GAO-11-450T, "Joint Strike Fighter: Restructuring Should Improve Outcomes, but Progress Is Still Lagging Overall," March 15, 2011

Report No. GAO-11-323R, "Tactical Aircraft: Air Force Fighter Force Structure Reports Generally Addressed Congressional Mandates, but Reflected Dated Plans and Guidance, and Limited Analyses," February 24, 2011

Report No. GAO-11-171R, "Defense Management: DOD Needs to Monitor and Assess Corrective Actions Resulting from Its Corrosion Study of the F-35 Joint Strike Fighter," December 16, 2010

Report No. GAO 10-1020R, "Joint Strike Fighter: Assessment of DOD's Funding Projection for the F136 Alternate Engine," September 15, 2010

Report No. GAO-10-789, "Tactical Aircraft: DOD's Ability to Meet Future Requirements is Uncertain, with Key Analyses Needed to Inform Upcoming Investment Decisions," July 29, 2010

Report No. GAO-10-388SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 30, 2010

Report No. GAO-10-478T, "Joint Strike Fighter: Significant Challenges and Decisions Ahead," March 24, 2010

Report No. GAO-10-382, "Joint Strike Fighter: Additional Costs and Delays Risk Not Meeting Warfighter Requirements on Time," March 19, 2010

Report No. GAO-10-520T, "Joint Strike Fighter: Significant Challenges Remain as DOD Restructures Program," March 11, 2010

Report No. GAO-09-711T, "Joint Strike Fighter: Strong Risk Management Essential as Program Enters Most Challenging Phase," May 20, 2009

Report No. GAO-09-326SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 30, 2009

Report No. GAO-09-303, "Joint Strike Fighter: Accelerating Procurement before Completing Development Increases the Government's Financial Risk," March 12, 2009

Report No. GAO-08-782T, "Defense Acquisitions: Better Weapon Program Outcomes Require Discipline, Accountability, and Fundamental Changes in the Acquisition Environment," June 3, 2008

Report No. GAO-08-467SP, "Defense Acquisitions: Assessments of Selected Weapon Programs," March 31, 2008

Report No. GAO-08-569T, "Joint Strike Fighter: Impact of Recent Decisions on Program Risks," March 11, 2008

Report No. GAO-08-388, "Joint Strike Fighter: Recent Decisions by DOD Add to Program Risks," March 11, 2008

DoD IG

Report No. DODIG-2013-031, "Audit of the F-35 Lightning II Autonomic Logistics Information System (ALIS)," December 10, 2012

Appendix C

Notices of Concern and JPO Responses

NOC Lockheed Martin

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

APR 2 5 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program
(Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern (NOC) to inform you that the Department of Defense, Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance assessment[1] of the F-35 program at Lockheed Martin Aeronautics (LMA), Fort Worth, Texas, from March 26, 2012 to April 6, 2012, the team identified 70 findings, 29 of which we consider to be major (systemic) and 41 to be minor.

We sorted the findings into six broad categories: Document Control, Risk Management, Process Discipline, Process Proofing, Foreign Object Debris (FOD), and Critical Safety Items (CSI). Our assessment of each of these areas is as follows:

- Document and configuration control is weak and needs management attention.
- Risk management needs to be handled upfront programmatically and technically.
- Process discipline is lacking in many areas reviewed by the team.
- Production processes have not been thoroughly proofed.
- FOD discipline is lacking and requires major cultural changes.
- CSI Development needs immediate and complete implementation.

On average, at final assembly each aircraft has 200+ corrective actions requiring rework or repair. The DoD IG team's overall conclusion is that LMA's, Fort Worth, Texas quality management system and the integrity of the F-35 product are jeopardized by a lack of attention to detail, inadequate process discipline, and a "we will catch it later" culture. We believe the quality assurance culture at LMA, Fort Worth, Texas must improve and that robust technical oversight by the government is required to ensure program performance and mission success.

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you disagree with the recommendations or any part of them, please give specific reasons why you disagree and propose alternative action if appropriate. Once we complete our five assessments,

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[1] The assessment was conducted in accordance with the Council of the Inspector General on Integrity and Efficiency (CIGIE) Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC Lockheed Martin (cont'd)

[redacted]

we will provide a report on our findings, along with any additional matters that might come to our attention.

We should receive your comments by May 25, 2012. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone, SES
Deputy Inspector General
Policy and Oversight

Attachments:
As stated

2

[redacted]

JPO Response to NOC Lockheed Martin

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II
To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

MAY 23 20

Subj: RESPONSE, NOTICE OF CONCERN - QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 25 April 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to Lockheed Martin Aeronautics (LMA), Fort Worth, Texas from 26 March to 6 April 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures, to include Aviation Critical Safety Items. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA) and LMA, reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to LMA as valid. I agree that all of the recommendations issued relative to LMA should be assessed and implemented to the maximum practicable extent. Additionally, the F-35 JPO reviewed the findings and recommendations issued relative to the F-35 JPO, and I also accept all of these findings as valid. I accept all of the recommendations issued relative to the F-35 JPO. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of selected LMA subcontractors.

DAVID J. VENLET
Vice Admiral, U.S. Navy

Appendix A

JPO Response to NOC Lockheed Martin (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

Copy to:
OUSD(AT&L)
Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC Lockheed Martin (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA) and LMA, reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to LMA as valid. I agree that all of the recommendations issued relative to LMA should be assessed and implemented to the maximum practicable extent. Additionally, the F-35 JPO reviewed the findings and recommendations issued relative to the F-35 JPO, and I also accept all of these findings as valid. I accept all of the recommendations issued relative to the F-35 JPO and will implement them as discussed below. Although we may discover, during our root cause analysis and development of corrective action plans, that a particular aspect of a finding may be already addressed and fixed to satisfy requirements, I believe that every finding has a deficiency that needs to be further addressed by our program office. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to LMA, the F-35 JPO's first step was to establish a joint working group among the F-35 JPO, LMA, and DCMA to ensure that all of the findings and recommendations are understood and to start developing corrective action plans. Points of Contact were established by 9 May 2012 for every finding within each of the three organizations, and discussions have already commenced. The F-35 JPO then notified DCMA of our intent to accept all of the findings (14 May 2012). DCMA is issuing Level 2 Corrective Action Requests (CARs) for each finding (on-going, ECD 31 May 2012). The DCMA CAR process provides the Government a systematic approach to ensure the Contractor takes corrective action in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization, will implement monthly adjudication meetings with each location included in the assessment to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with LMA will be held in July 2012.

3. Regarding the findings issued relative to the F-35 JPO, we are pursuing the following process.

JPO Response to NOC Lockheed Martin (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

a. Of the seven findings issued relative to the F-35 JPO, two address concerns regarding documentation of meetings for the Program Management Advisory Board and Test Readiness Reviews. In accordance with your recommendations, this will be addressed by 31 August 2012.

b. Four findings deal with the program implementation of Critical Safety Item (CSI) management. Your recommendations direct the F-35 JPO to implement a fully realized CSI plan, which we fully support. An F-35 CSI-Specific Implementation Policy has been developed. That document is being updated to communicate the additional CSI requirements and guidance in order to address the DoDIG's findings. The updated policy will form the basis of the JPO plans to put the Prime Contractor on contract for Phase I (Prime Contractor CSI) and Phase II (Supplier CSI) CSI Non-recurring engineering (NRE)effort, as well as the CSI recurring efforts. We plan to work with our Prime Contractor in the next several weeks to develop a CSI roadmap/schedule for the CSI program. The F-35 JPO is working to update and authorize the Phase I CSI NRE request for proposal.

c. The F-35 JPO accepts the final finding ,4LM005, which identifies the following issues: "a) JPO does not have a [Diminishing Manufacturing Sources and Material Shortages] DMSMS Program Management Plan as required by SECNAVINST 5000.2E (and previous revisions) or DoD 4140.1R. b) DMSMS management activities have not been funded in the Low Rate Initial Production (LRIP) 4 and 5 contracts. Therefore, a proactive DMSMS management process is not being implemented by LM or its suppliers on the F-35." We fully accept the first part of the finding regarding the lack of a DMSMS Program Management Plan, but it is important to point out that we do have some DMSMS activities on contract. Prior to 8 July 2011, DMS non-recurring/redesign and management activities were performed under the SDD contract. After that date, DMS management activities are being performed under the sustainment portion of the LRIP 5 contract. Beginning with the definitization of the LRIP 5 production Undefinitized Contract Action, which is currently being negotiated, all future DMS management and non-recurring/redesign activities will be included as part of the production contract. The JPO fully supports your recommendation to implement a robust DMSMS program and flow that down to LMA.

NOC Northrop Grumman

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

JUN 13 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense, Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance Assessment[1] of the F-35 program at Northrop Grumman Corporation (NGC), El Segundo and Palmdale, California, from May 7, 2012 to May 18, 2012, the team identified 66 findings.

We arranged the findings into five broad categories: Document Control, Requirements Flow-Down, Process Proofing, Process Discipline, and Tool and Equipment Control. Our assessment of each of these areas is as follows:

- Document Control–Plans, procedures, and records were not always maintained
- Requirements Flow-Down–Contractual and/or Federal Acquisition Regulation requirements were not always correctly flowed down and/or implemented
- Process Proofing–Production processes and work instructions were not well-defined and/or incomplete
- Process Discipline–Failure to follow established procedures was prevalent throughout most quality management processes
- Tool and Equipment Control–Tools and/or equipment were not properly identified, proofed, and controlled

The DoD IG team's overall conclusion is that NGC's quality management system is not always implemented or sufficiently defined; however, management is actively engaged in the day-to-day production activities and proactively working issues as they arise. Their general attitude was that the issues noted by the DoD IG assessment team were opportunities to improve their product.

[1] We conducted the assessment in accordance with the Council of the Inspector General on Integrity and Efficiency Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC Northrop Grumman (cont'd)

[redacted]

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you disagree with the recommendations or any part of them, please give specific reasons why you disagree and propose alternative action if appropriate. Once we complete our five assessments, we will provide a report on our findings, along with any additional matters that might come to our attention.

We should receive your comments by July 13, 2012. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachments:
As stated

2

[redacted]

JPO Response to NOC Northrop Grumman

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II
To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

JUL 9 2012

Subj: RESPONSE, NOTICE OF CONCERN - QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 13 Jun 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to Northrop Grumman Corporation (NGC), El Segundo and Palmdale, California, 7-18 May 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures, to include Aviation Critical Safety Items. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), NGC, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to NGC and LMA as valid. I agree that all of the recommendations issued relative to NGC and LMA should be assessed and implemented to the maximum practicable extent. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected LMA subcontractors.

David J. Venlet
DAVID J. VENLET
Vice Admiral, U.S. Navy

Appendix A

Copy to:
OUSD(AT&L)

JPO Response to NOC Northrop Grumman (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC Northrop Grumman (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), NGC, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to NGC and LMA as valid. I agree that all of the recommendations issued relative to NGC and LMA should be assessed and implemented to the maximum practicable extent. Although we may discover, during our root cause analysis and development of corrective action plans, that a particular aspect of a finding may be already addressed and fixed to satisfy requirements, I believe that every finding has a deficiency that needs to be further addressed by our program office. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to NGC, the F-35 JPO established a joint working group among the F-35 JPO, NGC, LMA, and DCMA to ensure that all of the findings and recommendations are understood and to start developing corrective action plans. Points of Contact within each of the four government organizations will be established for every finding by 18 July, but discussions have already commenced. The F-35 JPO has begun working with DCMA at both NGC sites to understand and properly characterize each finding with an eye towards drafting Corrective Action Requests (CARs) for appropriate findings (on-going, ECD 18 July 2012). The DCMA CAR process provides the Government a systematic approach to ensure that corrective actions are taken in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization and LMA, will implement monthly adjudication meetings with each location included in the assessment to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with NGC, LMA, and DCMA will be held in August 2012.

3. Findings issued relative to LMA have been rolled into the tracking process initiated during the initial visit to LMA and will be included in the LMA monthly tracking meetings.

NOC L-3 Communications

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

JUL 1 1 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense, Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance Assessment[1] of the F-35 program at L-3 Communications, Alpharetta, Georgia, from June 18, 2012 to June 22, 2012, the team identified 56 findings.

We sorted the findings into five broad categories: Process Discipline, Document Control, Requirements Flow-Down, Tool and Equipment Control, and Process Proofing. Our assessment of each of these areas is as follows

- Process Discipline–Failure to follow established procedures was prevalent throughout most quality management processes reviewed
- Document Control–Plans, procedures, and records were not always maintained
- Requirements Flow-Down–Contractual and/or Federal Acquisition Regulation requirements were not always correctly flowed down and/or implemented
- Tool and Equipment Control–Tools and/or equipment were not properly controlled, and the calibration system had serious deficiencies
- Process Proofing–Production processes and work instructions were not well-defined and/or incomplete

The DoD IG team's overall conclusion is that L-3's quality management system is not always implemented or sufficiently defined. Approximately half (43 percent) of the findings were in process discipline, indicating a lack of attention to detail. In addition, the calibration system had serious deficiencies that warrant a complete review, and first article inspections were not being performed as required.

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you disagree with the recommendations or any part of them, please give specific reasons why you

[1] We conducted the assessment in accordance with the Council of the Inspector General on Integrity and Efficiency Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC L-3 Communications (cont'd)

[redacted]

disagree and propose alternative action if appropriate. Once we complete our assessments, we will provide a report on our findings, along with any additional matters that might come to our attention.

We should receive your comments by August 13, 2012. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachment:
As stated

2

[redacted]

JPO Response to NOC L-3 Communications

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II
To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

Subj: RESPONSE, NOTICE OF CONCERN – QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 11 Jul 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to L-3 Communications, Alpharetta, Georgia, 18-22 June 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), L-3, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to L-3 and LMA as valid. I agree that all of the recommendations issued relative to L-3 and LMA should be assessed and implemented to the maximum practicable extent. The JPO acknowledges the findings issued against DCMA Fort Worth and DCMA Atlanta, and will collaborate with DCMA to ensure recommendations are assessed and implemented to the maximum practicable extent. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected LMA subcontractors.

DAVID J. VENLET
Vice Admiral, U.S. Navy

JPO Response to NOC L-3 Communications (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

Appendix A

Copy to:
OUSD(AT&L)
Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC L-3 Communications (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), L-3, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to L-3 and LMA as valid. I agree that all of the recommendations issued relative to L-3 and LMA should be assessed and implemented to the maximum practicable extent. Although we may discover, during our root cause analysis and development of corrective action plans, that a particular aspect of a finding may be already addressed and fixed to satisfy requirements, I believe that every finding has a deficiency that needs to be further addressed by our program office. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to L-3, the F-35 JPO established a joint working group among the F-35 JPO, L-3, LMA, and DCMA to ensure that all of the findings and recommendations are understood and to start developing corrective action plans. Points of Contact within each of the four organizations will be established for every finding by 10 August 2012, but discussions have already commenced. The F-35 JPO has begun working with DCMA at L-3 to understand and properly characterize each finding with an eye towards drafting Corrective Action Requests (CARs) for appropriate findings (on-going, ECD 31 August 2012). The DCMA CAR process provides the Government a systematic approach to ensure that corrective actions are taken in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization and LMA, will implement monthly adjudication meetings with each location included in the assessment to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with L-3, LMA, and DCMA will be held in September 2012.

3. Findings issued relative to LMA have been rolled into the tracking process initiated during the initial visit to LMA and will be included in the LMA monthly tracking meetings.

4. Findings issued relative to DCMA Fort Worth and DCMA Atlanta are being actively addressed. DCMA Atlanta has ensured proper

JPO Response to NOC L-3 Communications (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

procedures are in place and personnel properly trained to conduct the required inspections. They have developed a revised Quality Assurance Surveillance plan for L-3 Display Systems and are developing an internal procedure for "Delegation Review and Receipt," which will be completed by 31 August 2012.

DMCA Fort Worth has reviewed their Letters of Delegation to ensure all information is correctly reflected, which is expected to be complete by 31 August 2012. DCMA Fort Worth is also modifying their F-35 Suppliers Information Delegation to include a Monthly Reporting Requirements column, and will follow up within one business day if the deadline for reporting is missed. Finally, DCMA is implementing a new procedure to extract/compile and forward to the cognizant DCMA office performance data relating to those assigned suppliers whose performance is below LM's Supplier Quality Rating or that have received related product deficiency reports. They are updating their Surveillance strategy and desk top instructions to reflect this change, which will be completed by 30 September 2012.

NOC Honeywell - Phoenix, AZ

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

JUL 26 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense, Inspector General (DoD IG) team identified an issue that requires attention. During a pre-assessment visit at Honeywell, Phoenix, AZ, on July 19, 2012, we found that DCMA Phoenix has not been delegated oversight of production from DCMA, Lockheed Martin Fort Worth. This lack of delegation could result in quality escapes as DCMA surveillance and quality oversight functions are not being performed. It should be noted that DCMA Phoenix does have a delegation for repair and rework.

Our finding is attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendation. If you agree with our recommendation, describe what actions you have taken or plan to take to accomplish the recommendation and include the completion dates of your actions. If you disagree with the recommendation or any part of it, please give specific reasons why you disagree and propose alternative action if appropriate.

We should receive your comments by August 13, 2012. If you consider any matters exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of an actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Carolyn R. Davis
for Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachment:
As stated

[redacted]

JPO Response to NOC Honeywell - Phoenix, AZ

F-35 JOINT PROGRAM OFFICE
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II
To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

Subj: RESPONSE, NOTICE OF CONCERN - QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 26 Jul 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to Honeywell, Phoenix, AZ, on 19 July 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), reviewed the single finding and recommendation. The JPO acknowledges the finding issued against DCMA Ft Worth, and will collaborate with DCMA to ensure recommendations are assessed and implemented to the maximum practicable extent. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected Lockheed Martin Aeronautics subcontractors.

DAVID J. VENLET
Vice Admiral, U.S. Navy

Appendix A
Copy to:
OUSD(AT&L)
Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC Honeywell - Phoenix, AZ (cont'd)

F-35 JOINT PROGRAM OFFICE
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), reviewed the single finding and recommendation. The finding issued relative to DCMA Ft Worth is being actively addressed. They have added a supporting Letter of Delegation for the Turbo Machine. The subsequent Letter of Delegation from DCMA Santa Ana was accepted by DCMA Phoenix on 09 August 2012. We now have surveillance over the entire PTMS to now include repair of the Turbo Machine. The JSF JPO will continue to track the completion of the DCMA Corrective Action plan as part of the overall status of findings from all of the DoD IG Quality Assurance Assessments.

NOC BAE Systems

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

OCT 2 2 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance Assessment[1] of the F-35 program at BAE Systems, Samlesbury, United Kingdom, from September 18, 2012 to September 28, 2012, the team identified 82 findings.

We sorted the findings into five broad categories: Process Discipline, Document Control, Requirements Flowdown, Tool and Equipment Control and Calibration, and Process Proofing. Our assessment of each of these areas is as follows.

- Process Discipline–Processes are in place, but focus should be on attention to detail.
- Document Control–Plans, procedures, and records are not always maintained.
- Requirements Flowdown–Contractual requirements are not always correctly flowed down and/or implemented.
- Tool/Equipment Control/Calibration–Tools and/or equipment are not properly controlled, and the calibration system had serious deficiencies.
- Process Proofing–Processes are reliant on operator knowledge and training rather than documented processes.

The DoD IG team's overall conclusion is that BAE's quality management system is not always implemented or sufficiently defined. The production facility lacks tool controls, the calibration system suffers from serious deficiencies that warrant a complete review, and software test efforts need increased rigor and management participation. However, we found that the design review process is systematic, organized, and consistently implemented; the life cycle test effort was assessed to be effective; and workforce and management dedication, knowledge, skills, and abilities are driving BAE's success.

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you disagree with the recommendations or any part of them, please give specific reasons why you

[1] We conducted the assessment in accordance with the Council of the Inspector General on Integrity and Efficiency Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC BAE Systems (cont'd)

[redacted]

disagree and propose alternative action if appropriate. Once we complete our assessments, we will provide a report on our findings, along with any additional matters that might come to our attention.

We should receive your comments by November 21, 2012. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachment:
As stated

2

[redacted]

JPO Response to NOC BAE Systems

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II
To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

Subj: RESPONSE, NOTICE OF CONCERN - QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 22 Oct 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to BAE Systems, Samlesbury, United Kingdom, 18-28 September 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), the United Kingdom Ministry of Defence (MOD), BAE, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to BAE and LMA as valid. I agree that all of the recommendations issued relative to BAE and LMA should be assessed and implemented to the maximum practicable extent. The JPO acknowledges the finding issued against DCMA Northern Europe, and will collaborate with DCMA to ensure recommendations are assessed and implemented to the maximum practicable extent. I accept the finding and recommendation relative to the Joint Program Office as valid. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected F-35 suppliers.

DAVID J. VENLET
Vice Admiral, U.S. Navy

JPO Response to NOC BAE Systems (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

Appendix A

Copy to:
OUSD(AT&L)
Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC BAE Systems (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), the United Kingdom Ministry of Defence (MOD), BAE, and the prime contractor, Lockheed Martin Aeronautics (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to BAE and LMA as valid. I agree that all of the recommendations issued relative to BAE and LMA should be assessed and implemented to the maximum practicable extent. I believe that every finding has a deficiency that needs to be further addressed by our program office. However, we may discover during our root cause analysis and development of corrective action plans that a particular aspect of a finding may already be satisfactorily addressed and fixed. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to BAE, the F-35 JPO has established a recurring joint working group among the F-35 JPO, BAE, LMA, MOD and DCMA to ensure that all of the findings and recommendations are understood and to develop corrective action plans. Points of Contact within each of the four organizations were established for every finding on 5 November 2012, and discussions have commenced. The F-35 JPO has worked with DCMA at BAE to understand and properly characterize each finding and DCMA has issued Corrective Action Requests (CARs) for appropriate findings. The DCMA CAR process provides the Government a systematic approach to ensure that corrective actions are taken in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization, MOD, and LMA, will implement monthly adjudication meetings with BAE to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with BAE, LMA, MOD, and DCMA will be held in December 2012.

3. Findings issued relative to LMA have been rolled into the tracking process initiated during the initial visit to LMA and will be included in the LMA monthly tracking meetings.

JPO Response to NOC BAE Systems (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

4. The finding relative to DCMA Northern Europe (DCMA NE) is being actively addressed. DCMA NE has been granted the authority to increase staff by 2 Engineers and 2 QA representatives in an effort to increase the number of Nonconformance Material (NCM) actions reviewed. As well, DCMA NE will submit an alternate approach plan, per DCMA policy, to DCMA HQ Operations Directorate for approval for the reason that 100% review of the supplier's NCM submittals is not feasible due to increases in NCMs related to increases in aircraft production. This action will be completed by March 15, 2013. Regarding the issue of failure to delegate Material Review Board (MRB) authority to DCMA Representatives at BAE System (BAES) suppliers; DCMA NE is working with DCMA Ft Worth to make certain the proper contract requirement is levied on BAES by Lockheed Martin (LM). The requirement levied on BAES will stipulate that all NCMs shall be submitted to the onsite Government representative for concurrence and will be obligatory throughout the BAES supply chain. This will allow DCMA NE to issue delegations, reinforced by applicable contract documents, which will enable the proper level of oversight of Material Review Board processes. These actions will be completed by 15 March 2013.

5. As the F-35 Program defines its Critical Safety Item (CSI) development and implementation requirements, the JPO will continue to take DoDIG's recommendations into consideration. The JPO plans to collaborate with DCMA Headquarters and DCMA Ft Worth to determine how best to leverage the Engineering Support Activity's CSI delegation (to LMA and DCMA) on minor nonconformance and class II engineering change proposals within the CSI policies to ensure that adequate checks and balances are in place to support the F-35 CSI program. The CSI responsibility delegation will be formally flowed down to the Prime Contractor and DCMA through F-35 contracts and other program plans related to CSI and the JPO/DCMA Memorandum of Agreement (MOA).

NOC Honeywell - UK

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

NOV 2 0 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance Assessment[1] of the F-35 program at Honeywell Aerospace, Yeovil, United Kingdom, from October 29, 2012 to November 2, 2012, the team identified 38 findings.

We sorted the findings into five broad categories: Process Discipline, Document Control, Requirements Flowdown, Tool and Equipment Control and Calibration, and Process Proofing. Our assessment of each of these areas is as follows.

- Process Discipline–Failure to follow established procedures was prevalent throughout most quality management processes reviewed.
- Document Control–Plans, procedures, and records are not always maintained.
- Requirements Flowdown–Contractual requirements are not always correctly flowed down and/or implemented.
- Tool/Equipment Control/Calibration–Tools and/or equipment are not properly controlled.
- Process Proofing– Production processes and work instructions were not well-defined and/or incomplete.

The DoD IG team's overall conclusion is that Honeywell's quality management system is not always implemented or sufficiently defined. Over half (60 percent) of the findings were in process discipline, indicating a lack of attention to detail. In addition, the design review process and training system had serious deficiencies that warrant a complete review.

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you disagree with the recommendations or any part of them, please give specific reasons why you disagree and propose alternative action if appropriate. Once we complete our assessments, we

[1] We conducted the assessment in accordance with the Council of the Inspector General on Integrity and Efficiency Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC Honeywell - UK (cont'd)

[redacted]

will provide a report on our findings, along with any additional matters that might come to our attention.

We should receive your comments by December 21, 2012. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachment:
As stated

2

[redacted]

JPO Response to NOC Honeywell - UK

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II

DEC 11 2012

To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

Subj: RESPONSE, NOTICE OF CONCERN – QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 20 Nov 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to Honeywell Aerospace, Yeovil, United Kingdom, 29 October – 2 November 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), the United Kingdom Ministry of Defence (MOD), the F-35 prime contractor, Lockheed Martin, and its suppliers, Honeywell, and BAE Systems, reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to Honeywell and BAE as valid. I agree that all of the recommendations issued relative to Honeywell and BAE should be assessed and implemented to the maximum practicable extent. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected F-35 suppliers.

CHRISTOPHER C. BOGDAN
Lieutenant General, U.S. Air Force

Appendix A

Copy to:
OUSD(AT&L)
Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC Honeywell - UK (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), the United Kingdom Ministry of Defence (MOD), the F-35 prime contractor, Lockheed Martin Aerospace (LMA), and its suppliers, Honeywell and BAE Systems, reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to Honeywell and BAE as valid. I agree that all of the recommendations issued relative to Honeywell and BAE should be assessed and implemented to the maximum practicable extent. I believe that every finding has a deficiency that needs to be further addressed by our program office. However, we may discover during our root cause analysis and development of corrective action plans that a particular aspect of a finding may already be satisfactorily addressed and fixed. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to Honeywell, the F-35 JPO has established a recurring joint working group among the F-35 JPO, Honeywell, BAE, LMA, MOD and DCMA to ensure all of the findings and recommendations are understood and to start developing corrective action plans. Points of Contact within each of the four organizations have been established for every finding and discussions have already commenced. The F-35 JPO has begun working with DCMA at Honeywell to understand and properly characterize each finding with an eye towards drafting Corrective Action Requests (CARs) for appropriate findings (on-going, ECD December 2012). The DCMA CAR process provides the Government a systematic approach to ensure that corrective actions are taken in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization, MOD, and Honeywell, will implement monthly adjudication meetings with each location included in the assessment to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with Honeywell, BAE, MOD, and DCMA will be held in January 2012.

3. Regarding the finding issued relative to BAE Systems; it has been rolled into the tracking process initiated during the firstvisit to BAE Systems, Samlesbury, United Kingdom, and will be included in the BAE monthly tracking meetings.

NOC UTAS

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
4800 MARK CENTER DRIVE
ALEXANDRIA, VIRGINIA 22350-1500

DEC 19 2012

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICE JOINT STRIKE FIGHTER

SUBJECT: Notice of Concern–Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003)

We are issuing this Notice of Concern to inform you that the Department of Defense Inspector General (DoD IG) team identified issues that require your attention. During the Quality Assurance Assessment[1] of the F-35 program at United Technologies Corporation, Aerospace Systems (UTAS), performed at the Independence, Ohio and Fort Worth, Texas facilities from November 27, 2012 to December 5, 2012, the team identified 51 findings.

We sorted the findings into five broad categories: Process Discipline, Document Control, Requirements Flowdown, Tool and Equipment Control and Calibration, and Process Proofing. Our assessment of each of these areas is as follows.

- Process Discipline–Failure to follow established procedures was prevalent throughout most quality management processes reviewed.
- Document Control–Plans, procedures, and records are not always maintained.
- Requirements Flowdown–Contractual requirements are not always correctly flowed down and/or implemented.
- Tool/Equipment Control/Calibration–Tools and/or equipment are not properly controlled.
- Process Proofing– Production processes and work instructions were not well-defined and/or incomplete.

The DoD IG team's overall conclusion is that UTAS's quality management system requires significant focus in a couple of key areas. These areas include the proper implementation of quality and manufacturing processes and the flow down of F-35 program requirements to suppliers. In addition, attention to documentation maintenance needs to be a priority.

Our findings are attached to this memorandum for your review and comment. DoD Directive 7650.3 requires that recommendations be resolved promptly. Please provide comments that state whether you agree or disagree with the findings and recommendations. If you agree with our recommendations, describe what actions you have taken or plan to take to accomplish the recommendations and include the completion dates of your actions. If you

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[1] We conducted the assessment in accordance with the Council of the Inspector General on Integrity and Efficiency Quality Standards for Inspection and Evaluation and guidance in AS9101, Quality Management Systems Audit Requirements for Aviation, Space, and Defense Organizations.

[redacted]

NOC UTAS (cont'd)

[redacted]

disagree with the recommendations or any part of them, please give specific reasons why you disagree and propose alternative action if appropriate.

If possible, send a portable document format (.pdf) file containing your comments to [redacted]. Copies of your comments must have the actual signature of the authorizing official for your organization. We are unable to accept the /Signed/ symbol in place of the actual signature. If you arrange to send classified comments electronically, you must send them over the SECRET Internet Protocol Router Network (SIPRNET).

We should receive your comments by January 16, 2013. We normally include copies of the comments in the report. If you consider any matters to be exempt from public release, you should mark them clearly for Inspector General consideration.

Once we complete our assessments, we will provide a report on our findings, along with any additional matters that might come to our attention. We appreciate the courtesies extended to the staff. Please direct questions to [redacted].

Randolph R. Stone
Deputy Inspector General
Policy and Oversight

Attachment:
As stated

2

[redacted]

JPO Response to NOC UTAS

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

From: Program Executive Officer, F-35 Lightning II

JAN 18 2013

To: Deputy Inspector General, Policy and Oversight
Department of Defense Inspector General

Subj: RESPONSE, NOTICE OF CONCERN – QUALITY ASSURANCE ASSESSMENT OF THE F-35 PROGRAM

1. I received and analyzed your 19 Dec 2012 Notice of Concern-Quality Assurance Assessment of the F-35 Program (Project No. D2012-DT0TAD-0003) regarding your visit to United Technologies Corporation, Aerospace Systems (UTAS), performed at the Independence, Ohio and Fort Worth, Texas facilities, 27 November-5 December 2012. I appreciate your team's efforts to assess conformity to F-35 quality management systems, contractual quality clauses, and internal processes and procedures. I view your assessment as a valuable tool to independently evaluate the areas for improvement within the F-35 Program, with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies. I take seriously my responsibility to ensure corrections are effectively implemented and the F-35 program office, in concert with OUSD(AT&L), will follow up at all identified locations to ensure compliance with corrective action plans.

2. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), and the F-35 prime contractor, Lockheed Martin Aerospace (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to UTAS and LMA. I agree that all of the recommendations issued relative to UTAS and LMA should be assessed and implemented to the maximum practicable extent. The JPO acknowledges the findings issued against DCMA Cleveland, and will collaborate with DCMA to ensure recommendations are assessed and implemented to the maximum practicable extent. A detailed discussion of our path forward is contained at Appendix A and is marked for Inspector General Consideration.

3. We will continue to work with you and your team during the quality assurance assessments of the remaining selected F-35 suppliers.

CHRISTOPHER C. BOGDAN
Lieutenant General, U.S. Air Force

Appendix A

Copy to:
OUSD(AT&L)

JPO Response to NOC UTAS (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

Director, Engineering
JSF Weapon System Program Manager
Director, Production
Director, Program Integration

JPO Response to NOC UTAS (cont'd)

JOINT STRIKE FIGHTER PROGRAM
200 12TH Street South, Suite 600
Arlington, Virginia 22202-5402

FOR INSPECTOR GENERAL CONSIDERATION

Appendix A:

1. The F-35 Joint Program Office (JPO), in concert with the Defense Contract Management Agency (DCMA), and the F-35 prime contractor, Lockheed Martin Aerospace (LMA), reviewed each of the assessment's findings and recommendations. I accept all of the findings issued relative to UTAS and LMA as valid. I agree that all of the recommendations issued relative to UTAS and LMA should be assessed and implemented to the maximum practicable extent. I believe that every finding has a deficiency that needs to be further addressed by our program office. However, we may discover during our root cause analysis and development of corrective action plans that a particular aspect of a finding may already be satisfactorily addressed and fixed. I take seriously my responsibility to ensure corrections are effectively implemented and the F-35 program office, in concert with OUSD(AT&L), will follow up at all identified locations to ensure compliance with corrective action plans. Further, I intend to ensure that any corrections and improvements do not stay restricted to one location but are distributed and implemented throughout the JSF enterprise.

2. Regarding the findings issued relative to UTAS, the F-35 JPO has established a recurring joint working group among the F-35 JPO, UTAS, LMA, and DCMA to ensure all of the findings and recommendations are understood and to start developing corrective action plans. Points of Contact within each of the four organizations have been established for every finding (completed 15 Jan 13) and discussions have already commenced. The F-35 JPO has begun working with DCMA at both UTAS locations and at LMA Fort Worth to understand and properly characterize each finding with an eye towards drafting Corrective Action Requests (CARs) for appropriate findings (on-going, ECD 15 Feb 13). The DCMA CAR process provides the Government a systematic approach to ensure that corrective actions are taken in a timely manner. The F-35 JPO, in concert with the responsible DCMA organization, UTAS, and LMA, will implement monthly adjudication meetings with each location included in the assessment to ensure appropriate progress is being accomplished in the corrective action plan for each finding. The first meeting with UTAS, LMA, and DCMA will be held in March 2013.

3. Regarding the findings issued relative to LMA; they has been rolled into the tracking process initiated during the first visit to LMA, Fort Worth, and will be included in the LMA monthly tracking meetings.

4. The findings relative to DCMA Cleveland are being actively addressed. DCMA Cleveland has begun a scrub of actions identified in the Letters of Delegation from DCMA Lockheed Martin, Fort Worth to ensure that all are being addressed. DCMA Cleveland is working with the contractor to improve the flow of waivers/deviations, ensuring adequate reviews and recommendations are provided to the delegating authority. Regarding the finding on redelegation of Material Review responsibilities, DCMA Cleveland is assessing all documentation to ensure that correct delegations are in place. These actions will be completed by 15 April 2013

Appendix D

F-35 Joint Program Office and Defense Contract Management Agency Comments

F-35 LIGHTINING II JOINT PROGRAM OFFICE
200 12th Street South, Suite 600
Arlington, Virginia 22202-5402

AUG 23 2013

Mr. Randolph R. Stone
Deputy Inspector General Policy and Oversight
4800 Mark Center Drive
Alexandria, Virginia 22350-1500

Dear Mr. Stone,

Thank you for the opportunity to comment on your draft report, "Quality Assurance Assessment of the F-35 Lighting II Program", dated 5 August 2013.

Both the F-35 Joint Program Office (JPO) and the Defense Contract Management Agency (DCMA) take very seriously the findings and recommendations you offer in your report. We appreciate the DoD IG's efforts to improve the F-35 Program and found the DoD IG Team to be both professional and knowledgeable. As is noted in Enclosure 1, F-35 JPO and DCMA Response to Findings/Recommendations, we have been aggressively addressing these findings since the beginning of the assessment. The JPO and DCMA have initiated 343 Corrective Action Plans (CAPs) to address all 363 findings. As of 20 August 2013, 260 CAPs for specific contractor findings have been validated and closed, with 73 CAPs in work, and 10 CAPs to be approved. We are implementing corrective actions with the ultimate goal of producing a quality, timely, and cost-effective weapon system for the United States and our allies.

Enclosure 1 provides a detailed response for each finding and recommendation. Enclosure 2 provides recommended changes to verbiage in the draft report.

The action officers for this response are Mr. Tim Trayers, tim.trayers@jsf.mil (703) 601-5650 and Col Alex Stathopoulos, alex.stathopoulos@dcma.mil, (817) 763-4422.

Sincerely,

CHRISTOPHER C. BOGDAN
Lieutenant General, USAF
Program Executive Officer

MARIE A. GREENING
Chief Operations Officer
Defense Contract Management Agency

Enclosures:
1. F-35 JPO and DCMA Response to Findings/Recommendations

F-35 Joint Program Office and Defense Contract Management Agency Comments (cont'd)

2. F-35 JPO comments/recommended changes

cc:
OUSD (AT&L)
Assistant Secretary of the Navy (Research, Development & Acquisition)
SAF AQ Principal Deputy

F-35 Joint Program Office and Defense Contract Management Agency Comments (cont'd)

DEFENSE CONTRACT MANAGEMENT AGENCY
3901 A AVENUE, BUILDING 10500
FORT LEE, VIRGINIA 23801

August 29, 2013

MEMORANDUM FOR DEPARTMENT OF DEFENSE, INSPECTOR GENERAL, AUDIT POLICY AND OVERSIGHT

SUBJECT: Draft Report Quality Assurance Assessment of the F-35 Lightning II Program (Project No. D2012-DTOTAD-0003.000) dated August 5, 2013

Reference: DoDIG Draft Report Project No. D2012-DTOTAD-0003

We have attached the Headquarters, Defense Contract Management Agency's comments and documentation as requested.

The Point of contact for this our response is Col Stathopoulos at (817) 763-4422 or Alex.Stathopoulos@dcma.mil.

Richard H. Fanney
Deputy Chief Operations Officer
Operations Directorate

Attachment:
As stated

F-35 Joint Program Office and Defense Contract Management Agency Comments (cont'd)

Quality Assurance Assessment of the F-35 Lightning II Program
Project No. D2012-DT0TAD-0003.000
F-35 JPO and DCMA Findings, Recommendations and Responses

Finding A: The F-35 Joint Program Office (JPO) did not ensure that Lockheed Martin and its subcontractors were applying rigor to design, manufacturing, and quality assurance processes.

F-35 JPO Response: Agree
A rigorous design, manufacturing, and quality assurance process exists. The Program has continued to follow the DoD Systems Engineering process that spans from development through sustainment. Program plans such as the F-35 Systems Engineering Program Plan, F-35 Program Manufacturing Plan, and F-35 Quality Management Plan were written by the contractor, reviewed by JPO, and have been in place since early in the Systems Development and Demonstration (SDD) phase and continue to evolve as the Program matures. Program reviews such as Critical Design Reviews, Production Readiness Reviews, and various Quality Assurance reviews (for example First Article Inspections) have been put in place with the F-35 Joint Program Office and DCMA participation. Major reviews have detailed entrance and exit criteria to ensure requirements are defined, implemented, traceable, and verified by Program and Department of Defense Subject Matter Experts (SMEs) participating in the major reviews (providing both internal and independent assessments).

The F-35 baseline design has continued to evolve as a result of testing, producibility improvements, and affordability. Contractor and Government change boards are in use. Design change management has also evolved with the newly stood up Concurrency Integrated Product Team (IPT) which ensures that proper systems engineering, production, and sustainment reviews have been conducted and the change can be incorporated to meet cost, schedule, and performance requirements.

The Manufacturing plan has continued to evolve largely due to on-going concurrent design development and transition to rate production lines. Policies and procedures are in place to provide checks and balances in upgrading the manufacturing operations, production floor layouts and tooling, and procurement operations to ensure maintaining product integrity. Findings of independent audits by contractors, DCMA, and DoD IG highlight opportunities for improvement. These audits and DCMA inspections have helped ensure greater discipline in adhering to their policies and procedures already established. Additionally, the Defense Contract Management Agency (DCMA) had issued a Level III Corrective Action Request (CAR) on July 2010 for action to be taken in ensuring process discipline and procedural adherence.

Recommendation A1: (JPO) Ensure compliance to AS9100 throughout the F-35 supply chain.

F-35 JPO Response: Concur
AS9100 (Quality Management Systems – Requirements for Aviation, Space, and Defense Organizations) is an F-35 contractual requirement. The prime contractor (Lockheed Martin (LM)) is AS9100 certified and has flowed down this quality requirement to its supply chain. AS9100 certification is granted by a third party accredited entity. Periodic reviews are held by that third party entity to maintain certification. Annual self audits are conducted by both the prime contractor and its suppliers to monitor compliance within their respective facilities. The

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Government has had limited insight to results of these self audits, however, DCMA performs onsite process reviews as part of its oversight activity. DCMA at Lockheed Martin Fort Worth reorganized in February 2013 to provide more focus and inspection emphasis to ensure AS9100 compliance and a quality product. Additionally, JPO reviews AS9100 certification status of critical suppliers during their annual Production Readiness Reviews (PRR). These reviews serve as a LRIP risk management tool conducted with the prime contractor and selected major critical suppliers, covering Technical, Production and Sustainment requirements. Suppliers must demonstrate consistent adherence of product compliant to contractual (AS9100) and applicable statutory and regulatory requirements. Findings of this IG audit have caused both contractor and Government entities to adjust the frequency and scope of independent audits to ensure greater insight to AS9100 compliance.

Recommendation A.2: Ensure that Lockheed Martin approves all design and material review board changes and variances with Government concurrence.

F-35 JPO Response: Concur
Current F-35 Program plans (such as the Configuration Management Plan) require that all major design changes and variances for production aircraft receive Government concurrence. The Government maintains limited insight of the contractor's Material Review Board (MRB) process. Subsequently, the Government has reprioritized and refined its engagement in that process to ensure improved effectiveness. For nonconformances that require MRB disposition, JPO delegates the approval of Class II (minor) changes to DCMA and reviews all Class I changes that affect form, fit, or function. A Class I change request is dispositioned through the JPO Change Review Board (JCRB), which performs a technical and business assessment and provides a written recommendation to the Joint Configuration Control Board (JCCB). With the input of major stakeholders, the JCCB adjudicates the recommended change and provides that decision to Contracts, who notifies the Prime Contractor to proceed in incorporating the change.

Any subcontractor submittal for variances and engineering change requests, for which Lockheed Martin is the sole design authority, must be go through Lockheed Martin's change control boards for review and approval. Furthermore, Lockheed Martin must provide concurrence for engineering changes relating to subcontractor owned designs. Various configuration management checks and balances (such as Physical and Functional Configuration Audits) are in place to ensure control.

Recommendation A.3: (JPO) Perform process proofing of all critical processes to include first article inspections.

F-35 JPO Response: Partially Concur
The Government does not have the resources to perform process proofing of <u>all</u> critical processes. Responsibility and accountability rests on the prime contractor, with oversight from the Government. Process proofing and First Article Inspections are Program Plan and contractual requirements. The Government performs audits of process compliance to ensure the

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contractor is controlling critical operations. The Government closely monitors scrap, rework, and repair to ensure the contractor is conducting proper root cause analyses to implement appropriate corrective actions. The Government also monitors the quality of delivered product to ensure control of escaped defects.

JPO requires the contractor to perform First Article Inspections (FAI) and process proofing as part of their implementation of AS9100 and the F-35 Program Quality Management Plan. Over 27,500 original baseline FAIs have been completed and approximately 400 more delta FAIs will be performed for parts due to concurrency, producibility, process changes, etc. In addition, the prime contractor has implemented variation management, which is an advanced quality system technique that focuses on defect prevention and continuous improvement through the identification of key product and process characteristics. This allows greater control of the manufacturing process.

Recommendation A.4: (JPO) Modify its contracts to include a quality escape clause, to ensure the Government does not pay for nonconforming product.

F-35 JPO Response: Concur
JPO concurs that greater incentives should be taken to preclude the cost of poor quality. Major non-conformances that do not meet engineering specification are identified and adjudicated for acceptance or rejection with considerations/withholds placed on a variance. Minor non-conformances are reworked, repaired, or used as is. The program has transitioned to fixed price type contacts with a 0/100 share ratio and clauses will prescribe to applicable FAR requirements. Along with considerations / withholds on non-conformances, this contract structure will facilitate greater incentive by the contractor to provide quality assurance in order to maintain cost and schedule obligations without over running their negotiated budget. The contractor will absorb a level of cost for poor quality. In addition, the JPO continues to establish quality performance targets with commitments from JPO and LM senior leadership. These targets are based upon continuous learning in fabrication and assembly operations, corrective action implementation, in addition to product and process improvements as a result of affordability and concurrency changes.

Recommendation A.5: (JPO) Assess the impacts and risks to all delivered aircraft for all findings.

F-35 JPO Response: Concur
The impacts and risks of all findings were assessed as part of the Corrective Action Request (CAR)/Corrective Action Plan (CAP) process. When a CAR was written, the F-35 fleet was assessed for impact. Concurrence on each CAP considered effectivity, safety, and contract elements. This determined priority and timing required to implement the corrective action into the affected aircraft as appropriate.

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Finding B: JPO did not flow down critical safety item (CSI) requirements.

F-35 JPO Response: Agree
Public Law 108-36, section 802, requiring a Critical Safety Item program was introduced in fiscal 2004 legislation, three years after the F-35 SDD contract award. Further, guidance from DoD on how to implement CSI was not immediately forthcoming. As such, the F-35 program delayed CSI implementation pending clear policy and to minimize unnecessary cost growth. As the name implies, the focus of CSI is aviation safety. The F-35 program and contractor team treat safety as a Number 1 priority. The JPO's development specification includes stressing criteria for aviation safety (max loss of aircraft rate), hazard risk levels, and mission completion success criteria. Further, LM's engineering standard work requires a comprehensive product integrity program to ensure the safety and performance of safety / mission critical components, subsystems, and assemblies. Rigorous guidelines to include redundancy, backup systems, design and qualification standards, etc. are imposed on these components to ensure safety and performance. Many of the prescribed CSI practice, such as 100% inspection, are subsumed under the umbrella of the integrity programs: fracture critical; safety critical; durability critical; and mission critical. Nonetheless, JPO and the contractor developed and regularly update a list of CSI parts and assemblies. This list has been required on each LRIP contract to date. That said, the JPO is phasing in the remaining tenants of a CSI program through ongoing LRIP contracting actions and new SDD actions. For example, recent closure on the LRIP 6 contract includes additional CSI related tasks for variance management and notification.

Recommendation B.1: (JPO) Implement an aviation critical safety item program that meets the requirements of the Public Law and DoD Policy, which would include flow down of requirements for a critical safety item program to Lockheed Martin and its subcontractors.

F-35 JPO Response: Concur
JPO is working with the prime contractor in developing a Request for Proposal (RFP) for a two-phased CSI Non Recurring Engineering (NRE) approach. This will require the development of comprehensive CSI requirements which will be added to the SDD contract's Statement of Work. These requirements will address the identification of critical characteristics that enable compliance at the prime contractor and throughout its supply base. Once the SDD NRE efforts are completed, the full scope of the F-35 CSI program will be included in future production and sustainment contracts. Commencement of certain initial recurring tasks will be implemented using the LRIP 6 contract. In the interim, the contractors' integrity and quality programs are providing assurance for continued aviation safety.

Recommendation B.2: (JPO) Assess the impacts and risks to all delivered aircraft for critical safety item deficiencies.

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F-35 JPO Response: Concur
Deficiencies and impacts to critical parts are identified and assessed during quality assurance practices and testing operations as part of the SDD design and product verification processes. If safety issues and limitations are discovered, changes are initiated and incorporated as warranted to the test and production aircraft. Initial and continued airworthiness is a major focus of the F-35 Class Desk, Airworthiness Team, Integrated Test Team, and Integrated Product Teams. The SDD test aircraft have more than 5,000 flight hours. The combined F-35 fleet has accumulated more than 7,000 flight hours. This is not to say that there are no significant issues or discoveries. Rather, there is an upfront understanding whether any new discovery poses an increased safety risk. If necessary, proper actions are taken, such as suspending flight operations, directing inspections, adding flight limitations or restrictions, and directing hardware or software modifications to mitigate the safety risks.

Finding C: JPO did not ensure that Lockheed Martin flowed down quality assurance and technical requirements to subcontractors.

F-35 JPO Response: Partially Agree
Processes are in place, which ensure that requirements are flowed down from the prime contractor to its supply base. But, there are areas for improvement. A significant number of IG findings were noted in this area. The four key areas of highest concern were First Article Inspection, Configuration Control, Design and Development Requirements, and Diminishing Manufacturing Supply and Materiel Shortages.

First Article Inspection (FAI) - Although the IG finding states that there is a lack of definitive FAI requirement flowed down to the prime contractor's supply chain, all major suppliers are required to adhere to AS9100 in which FAI is addressed. AS9102, First Article Inspection, is used as a guideline to assist in meeting the AS9100 requirement. Validation of interface control features, key characteristics, interchangeability / replaceability, outer mold-line, coating application, and component end item inspections are conducted throughout major assemblies and tied to the aircraft acceptance (DD250) process. As such, LM does not require FAIs to be performed on major component assemblies such as the wing and the center, forward, and aft fuselages.

Configuration Control – The associated IG finding states that there is a lack of requirement flow down and communication between Lockheed Martin and its suppliers, leading to configuration management issues. The F-35 maintains a detailed Configuration Management Plan which describes configuration control through the prime contractor and its supply chain. Check and balances have been put in place to ensure configuration control. These checks and balances include (but are not limited to) Functional/Allocated/Product Baseline Reviews, First Article Inspections, Physical Configuration Reviews / Audits, Function Configuration Audits, and System Verification Reviews. Preparation for these major reviews serves as a means to

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communicate and understand the requirements between the prime contractor and its suppliers. Execution of such reviews validates compliance and ensures configuration control.

Design and Development Requirements - A key finding in this area dealt with a lack of flow down of Mission Systems Software Development requirements, in addition to verification and traceability of those requirements. It is true that there are challenges with traceability of mission systems requirements. However, it is not accurate to say that the requirements are untraceable. Traceability can be accomplished. The challenge is that the traceability requires access to several tools and is more manual in nature and not an automatic Dynamic Object Oriented Requirements System (DOORs) function. The finding also mentioned the lack of maintenance of the Air System Block Plan. This statement is inaccurate. At some point in time this statement may have been true, however, the Air System Block Plan is maintained via a Contract Data Requirements List (CDRL) that is updated every 6 months and the Program now has a Build Review Board that actively manages the capability content of the detailed build plans that constitute the higher level Block Plans. The Build Review Board monitors execution progress and planning of new software builds to ensure that capabilities are delivered on time based on a realistic schedule and acts as the Decision Body that makes informed trades to support software execution and LRIP production deliveries.

Diminishing Manufacturing Supply and Materiel Shortages (DMSMS) – This finding stated that JPO had not funded Lockheed Martin (LM) to implement a DMSMS program. The conversion from funding DMSMS on the SDD contract to the LRIP contracts was taking place when the IG was briefed. During this interim, DMSMS was not funded by the F-35 Joint Program Office. Potential risks were mitigated as a result of the prime contractor executing on internal company funding and converting to an Undefinitized Contract Authorization (UCA), with Full Authorization funded under LRIP 6. In addition, the DMSMS strategy was under review, the charter was signed, and the management plan was in draft by the F-35 Joint Program Office. The prime contractor also revised the Supply Chain Management Plan which now includes the DMSMS Team as a stakeholder, ensuring proper coordination. Furthermore the DMSMS Supplier Statement of Work requirement was updated to specifically require LM suppliers to flow down DMSMS requirements to sub-tier suppliers. Funding and improvements concerning DMSMS requirements have allowed better proactive parts obsolescence management.

Recommendation C: (JPO) Perform technical and quality assurance requirement flow down and verification throughout the F-35 supply chain.

F-35 JPO Response: Partially Concur
The Government does not have the responsibility or resources to perform requirement flow down verification throughout the prime contractor's entire supply chain. The prime contractor is responsible and accountable, with oversight from the Government. The Government performs spot checks and conducts surveillance to ensure the contractor is flowing down requirements to its subcontractors. The Government monitors this closely through participation in Design Reviews, Production Readiness Reviews, Structural Equivalency Reviews, Program Management Reviews, production floor inspections, configuration audits, etc. On site

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surveillance is primarily performed by DCMA to ensure the contractor and its subcontractors are complying with contractual requirements.

Finding D: JPO did not establish an effective quality assurance organization.

F-35 JPO Response: Agree
The F-35 Program management team is committed to establishing an effective Quality Assurance program and organization. It has empowered its Quality Team, under the Production IPT, to define measurable Program quality requirements and is engaged in creating a program environment that fosters continuous improvement. JPO's Quality Team is engaged during contract and product development to ensure quality considerations are considered. Their engagement continues through fabrication and assembly to ensure quality control and continuous improvement through aircraft delivery. JPO has integrated DCMA as part of its Quality Team, per the long standing and ongoing Program IPT structure and the Program's Memorandum of Agreement (MOA) with DCMA, to enhance quality surveillance and performance monitoring. DCMA serves as an on-site agent and is responsible for contract administration and has resources, training, and processes to effectively administer quality assurance. Their insight and oversight of contractor practices places them in the best position to identify, report, and address quality assurance issues. Based upon some of the IG findings, JPO and DCMA are in the process of refining their teaming structure to ensure more cogent focus on critical processes and product quality results.

JPO has formed a partnership with Lockheed Martin and DCMA. Each entity maintains its independent perspective, but is teamed to achieve a common goal - ensure the delivery of a quality product to US Services and International Partners' warfighters. It is through this arrangement that requirements are articulated, executed, verified, and controlled. The Government (JPO and DCMA) continues to work closely with the contractor's Program and Core Quality organizations to ensure adequate support is provided to meet Program objectives. As the Program transitions to Full Rate Production, JPO acknowledges the need for a focused quality organization.

Recommendation D: (JPO) Establish an independent quality assurance organization, which has the authority and resources to enforce the AS9100 standard and F-35 product quality.

F-35 JPO Response: Non-concur

JPO acknowledges opportunities to improve management of Quality performance and the benefits of realignment within the F-35 Program organizational structure to better support transition from Low Rate Initial Production to Full Rate Production. These efforts have commenced to include an increase in resources and realignment of the Quality Team to report to

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program leadership. The JPO non-concurs with establishing an independent quality assurance organization. DCMA performs the role of the independent quality assurance organization for the F-35 and other DoD programs. DCMA conducts process surveillance against the AS9100 standard and enforces F-35 product quality requirements. Additionally, the JPO Quality Team is staffed from two independent organizations; Air Force Life Cycle Management Center (AFLCMC) and Naval Air Systems Command (NAVAIR). While serving on the JPO Quality Team, these individuals retain their responsibility to invoke their independent AFLMC and NAVAIR leadership in the event the JPO does not properly address quality concerns.

Finding E: DCMA was not performing quality assurance oversight commensurate with product criticality. Insufficient written direction from the JPO coupled with inadequate execution from DCMA resulted in ineffective Government oversight of the F-35 program.

F-35 JPO Response: Agree

DCMA is an independent DoD component that works directly with Defense suppliers and buying agencies to ensure contract compliance. DCMA partnership with the JPO is crucial to delivery of the F-35. DCMA's oversight activities are focused on process surveillance to ensure systemic issues are adequately addressed. Nonconformances are assessed according to severity and recurrence. Corrective action requests have been generated to address nonconformances, in concert with communicating with JPO on the implementation of corrective actions. In addition, DCMA is an integral part of the Material Review Board (MRB) process. They will continue to review the classification of all nonconformance, raising issues which affect form, fit, or function to JPO attention, and providing disposition to minor nonconformance as required. DCMA also ensures that the prime contractor and its suppliers are adequately employing the MRB process. Contractor performance status is also provided monthly to JPO in functionally-aligned written reports.

JPO feedback is critical to DCMA. DCMA also relies on its Headquarter reviews to measure performance based upon agency policy, contract content, and customer expectations. JPO and DCMA have initiated improvements in their teaming relationship to include emphasizing priorities and exploring the sharing of resources. DCMA has been conducting surveillance activities throughout the supply chain since the beginning of the F-35 SDD contract. 137 Letters of Delegation (LODs) are in place with all major and critical parts suppliers and being continually updated to meet program needs. Additionally, as the Critical Safety Item (CSI) program matures, DCMA and JPO will continue refocusing limited assets to ensure coverage. DCMA (Ft Worth) and its delegated team will continue to utilize the Corrective Action Report (CAR) methodology to focus contractor efforts and resolve risks while enhancing CAR/Corrective Action Plan communication with the JPO.

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Recommendation E.1a (JPO): Revise the Defense Contract Management Agency memorandum of agreement to provide explicit surveillance criteria

F-35 JPO Response: Concur
The Memorandum of Agreement (MOA), annex A-P, dated February 2011, between the JPO and DCMA is being updated to reflect Program objectives requiring DCMA support in the following areas: Management of contractor Quality Process implementation, control, maturity, and verification; Material Review/Change Board Process authority and related task requirements, Foreign Object Damage (FOD) management, Government Flight Representative surveillance, Safety of Flight inspection requirements, contractual Corrective Action Request notification, Air system acceptance (DD250), Supply Chain Management, etc. However specific surveillance activities and priorities are articulated via other tools, such as Quality Assurance Letters of Inspection (QALI's).

It is important to note that the MOA update, though crucial in shaping organizational roles and responsibilities that address the findings in this report, is only part of the corrective action process being implemented. Execution of DCMA policies, enhanced communication between the JPO and DCMA, and enhanced inter-DCMA communications with supplier DCMA organizations all play a role in improving surveillance. In addition to the MOA, DCMA utilizes risk based surveillance plans to support F-35 contracts. As part of the functional surveillance planning process, DCMA determines what types of surveillance techniques will be applied to ensure a supplier has adequate quality processes in place and meet all contractual requirements. Risks are identified through historical knowledge of the suppliers systems and processes, results of surveillance execution, analysis of DCMA internal data, supplier data and customer data.

Recommendation E.1.b: (JPO) Ensure that Defense Contract Management Agency is performing quality assurance oversight commensurate with product criticality.

F-35 JPO Response: Concur
DCMA has been, and continues to be, responsive to product criticality while performing its contact administration quality assurance functions. This includes optimizing quality assurance oversight of contractors' critical processes, operations, and product. Product criticality is governed by Federal Acquisition Regulation derived surveillance strategies. FAR/DFAR regulatory requirements as manifest in F-35 contracts are also guided by DCMA policies. DCMA policies define risk considerations and thresholds in developing surveillance plans. Quality specialists determine what types of surveillance techniques will be applied to ensure a supplier has adequate quality processes in place. Surveillance activities and data analysis allow DCMA to re-evaluate risk levels and where appropriate adjust surveillance plans.

As non-conformance is identified, JPO may request special surveillance be performed in other areas due to severity or whether they are systematic in nature. This is captured in other documents such as QALI's. The DCMA monthly report also is a means of communicating quality assurance oversight as it pertains to production status. Continuous communication between JPO and DCMA to discuss and resolve quality issues is critical to meeting Program

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objectives. Performing quality assurance in accordance with product criticality is central to how DCMA conducts contract surveillance.

Recommendation E.2.a: (DCMA) Provide a comprehensive quality assurance oversight plan for Joint Program Office approval to be included in the memorandum of agreement.

F-35 DCMA Response: Partially Concur
DCMA will ensure the MOA, as currently being updated, complements DCMA risk based surveillance planning. The DMCA surveillance planning process is risk based and developed through historical knowledge of the suppliers systems and processes, results of surveillance execution, analysis of DCMA internal data, supplier data and customer data.

DCMA is also implementing a dedicated Supply Chain Management team at LMFW to address the significant supply chain oversight challenge of the F-35 program. The focus of the team will be to evaluate LMFWs supply chain processes and system as well as a more focused emphasis on risk suppliers throughout the Supply Chain.

Recommendation E.2b: (DCMA) Audit the execution of the quality assurance oversight plan throughout the F-35 supply chain.

F-35 DCMA Response: Concur
DCMA will comply with its quality assurance oversight plan. Regular audits of supplier and prime DCMA organizations are crucial to maximizing the effectiveness of risk based surveillance. Within DCMA, Management Review Teams (MRT) provide comprehensive functional reviews on our quality program. These risk-based audit efforts, are conducted by independent quality experts and occur throughout the entire DCMA organization ensuring coverage of the F-35 supply chain. Continued communication of audit results with our customers and enhanced communication between DCMA supplier CMOs will also supplement a robust audit process.

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Acronyms and Abbreviations

ANSI	American National Standards Institute
AS	Aerospace Standard
ATP	Acceptance Test Procedure
BOS	Back-Up Oxygen System
CAR	Corrective Action Request
CDR	Critical Design Review
CSI	Critical Safety Item
CTOL	Conventional Takeoff and Landing
CV	Carrier-Suitable Variant
DCMA	Defense Contract Management Agency
DMSMS	Diminishing Manufacturing Sources and Material Shortages
DOORS	Dynamic Object Oriented Requirements System
DU	Display Unit
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
EU	Electronics Unit
FAI	First Article Inspection
FMECA	Failure Modes, Effects, and Criticality Analysis
FOD	Foreign Object Debris
FRACAS	Failure Reporting, Analysis, and Corrective Action System
ICD	Interface Control Document
IEC	International Electrotechnical Commission
IPT	Integrated Product Team
ISO	International Organization for Standardization
JACG	Joint Aeronautical Commanders Group
JPO	Joint Program Office
JSF	Joint Strike Fighter
LOD	Letter of Delegation
LRIP	Low-Rate Initial Production
LSLM	Limited Shelf-Life Materials
NOC	Notice of Concern
OBOGS	On-Board Oxygen Generation System
OFI	Opportunity for Improvement
OIG	Office of Inspector General
PCD	Panoramic Cockpit Display
PDR	Preliminary Design Review

QN	Quality Notifications
SDD	Software Design Document
SDP	Software Development Plan
SOW	Statement of Work
SRS	Software Requirements Specification
STOVL	Short Takeoff and Vertical Landing
SVDD	Software Version Description
UTAS	United Technology Aerospace Systems
VDD	Version Description Document

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